IBM
580 BLDG.

INSTRUCTION MANUAL

FOR THE

VHF OSCILLATOR

3200A

HEWLETT PACKARD hp BOONTON DIVISION

1M/CP/1-65

Printed in U.S.A.

INSTRUCTION MANUAL

FOR THE

VHF OSCILLATOR

3200A

SERIALS PREFIXED: 450-

Copyright Hewlett-Packard 1965

BOONTON DIVISION

Green Pond Road Rockaway, New Jersey, U. S. A.

HEWLETT PACKARD hp BOONTON DIVISION

1M/CP/1-65

Printed in U.S.A.

TABLE OF CONTENTS

Section *Page*

I. DESCRIPTION

General 5
Front and Rear Panel Layout 5

II. SPECIFICATIONS 7

Specification Performance Testing 8

III. OPERATING INSTRUCTIONS

Operating Precautions 13
Installation 13
Using the Oscillator 13

IV. THEORY OF OPERATION

General 15
RF Oscillator 15
Attenuator 15
Modulation 15
Power Supply 17

V. OPERATIONAL GUIDE

Introduction 18
Output Level 18
RF Distortion 18
Typical Drift 19
Frequency Response (Modulation) 19
Amplitude Modulation 19

VI. MAINTENANCE

General 20
Preventative Maintenance 20
Trouble Shooting and Repair 20
Mechanical Disassembly Procedures 20
Adjustment and Calibration 23

VII. REPLACEMENT PARTS

General 26
List of Manufacturers 26
Reference Designation Index 26
Table of Replaceable Parts 29

LIST OF ILLUSTRATIONS

Figure No.	*Title*	*Page*
1.	Operating Controls and Layout	4
2.	3200A Dimensions	8
3.	AM Characteristics Setup	10
4.	AM Characteristics — Oscilloscope Displays	11
5.	PM Requirements Setup	11
6.	Block Diagram — 3200A	15
7.	RF Oscillator Circuit	16
8.	Amplitude Modulation — 3200A	16
9.	Pulse Modulation — 3200A	16
10.	Power Supply — 3200A	17
11.	Typical Maximum Power Output	18
12.	Typical RF Output Waveforms	18
13.	Typical Frequency Drift	19
14.	Typical Frequency Response	19
15.	Trouble Shooting and Repair Setup	22
16.	Dial Stringing	22
17.	RF Calibration Setup	25
18.	3200A — Power Supply	34
19.	3200A — RF Oscillator	35
20.	3200A — Front View, Front Panel Removed	36
21.	3200A — Front View	37
22.	3200A — Rear View	37
23.	3200A — Disassembled	38
24.	Printed Circuit Board (Z300)	38
25.	Voltage and Resistance Chart	39
26.	Schematic Diagram — 3200A	39

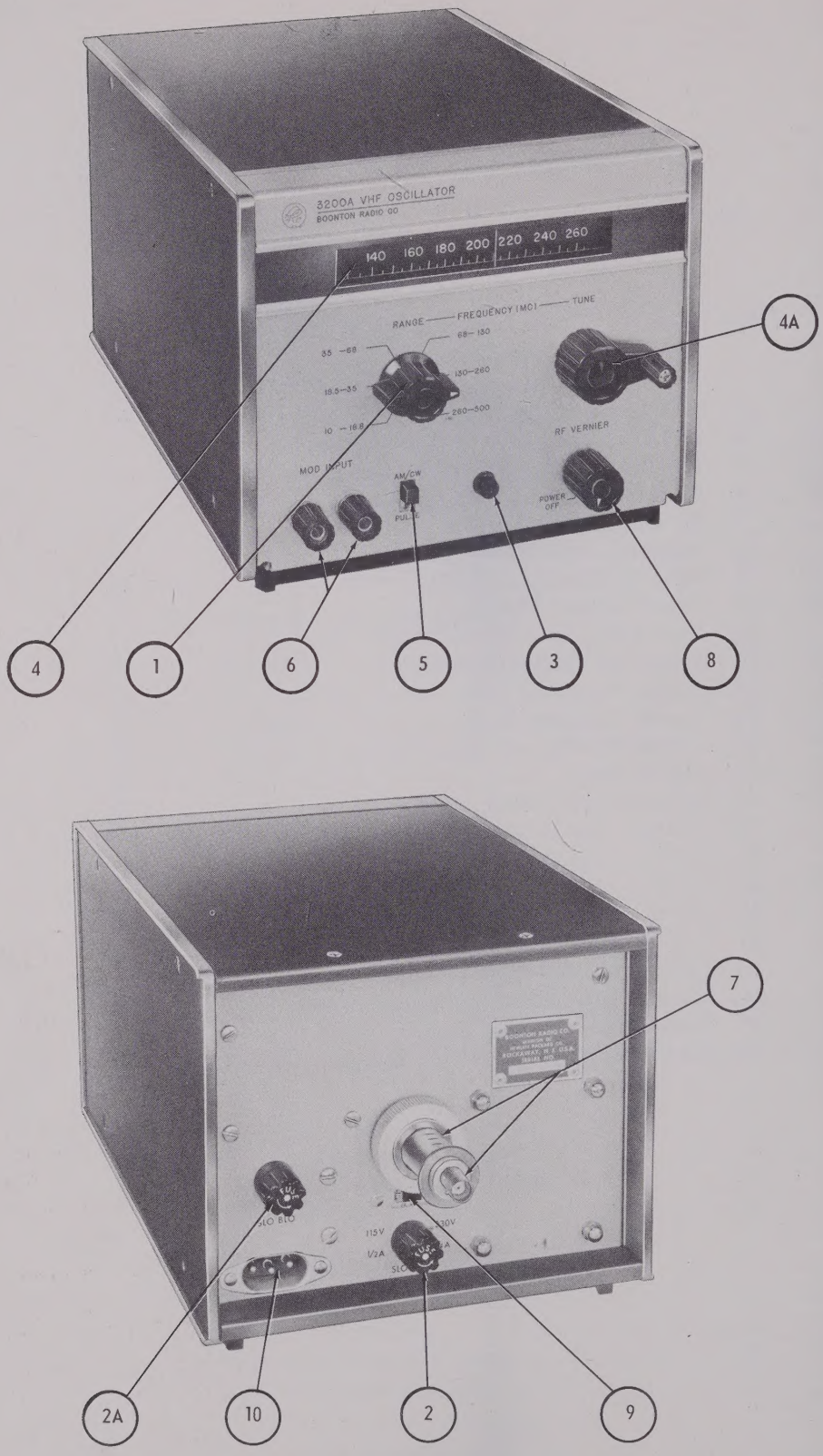


Fig. 1. Operating Controls and Layout

SECTION I
DESCRIPTION

GENERAL

The 3200A VHF Oscillator is designed for general purpose laboratory use in the frequency range of 10 to 500 mc. Typical applications include: receiver and amplifier testing; driving bridges, slotted lines, antenna and filter networks; and use as a local oscillator for heterodyne detector systems.

The push-pull oscillator is housed in a rugged aluminum casting for maximum stability and extremely low leakage. Six frequency ranges are provided for adequate bandspread on the slide-rule dial. Amplitude and pulse modulation may be obtained by the use of suitable external sources.

The RF output is coupled through a waveguide-below-cutoff variable attenuator. An electronic RF level vernier is included as a front panel control.

A solid-state power supply furnishes all necessary operating voltages, including dc to the oscillator tube heaters for minimum hum modulation and maximum tube life.

The VHF Oscillator is completely self-contained and housed in a modular cabinet which can be adapted, using a combining case or rack adapter frame, for standard rack mounting.

FRONT AND REAR PANEL LAYOUT

Front and rear views of the 3200A VHF Oscillator are shown in Fig. 1. In the following description, front panel designations are shown within quotation marks; rear panel designations are shown within parenthesis.

1. Range Switch "RANGE — FREQUENCY (MC)"

The range switch determines the frequency range of the output of the instrument.

2. Fuse (1/2 A — 1/4 A)

This fuse in the ac line is located on the rear panel of the instrument (1/2 amp for 105-125 v input, 1/4 amp for 210-250 v input).

2A. Fuse (1/16 A SLO-BLO)

This fuse in the B supply circuit is located on the rear panel of the instrument.

3. Pilot Light

4. Frequency Dial

The frequency dial shows the frequency scale for the range of the 3200A indicated by the range switch. The ranges and frequency calibration increments are as follows:

Range (mc)	*Increments (mc)*
10 to 18.8	0.2
18.5 to 35	0.5
35 to 68	1
68 to 130	2
130 to 260	5
260 to 500	10

4A. Frequency Control "FREQUENCY (MC) — TUNE"

The frequency control operates the Frequency Dial (4).

5. Modulation Input Switch "AM/CW — PULSE"

The modulation Input Switch disconnects B supply power in the PULSE position for pulse modulation with an infinite on-off ratio. In the AM/CW position the RF can be amplitude modulated up to 30% with less than 1% distortion.

The PULSE position of this switch puts the instrument in *Standby* condition.

6. Modulation Input Terminals "MOD INPUT"

These terminals provide a means whereby an external source of modulating voltage may be applied to the instrument.

NOTE: See Operating Instructions before attempting to use these terminals.

7. Output Attenuator and RF Output Connector

The output of the 3200A is available from the BNC connector which is a part of the piston attenuator located on the rear of the instrument. The attenuator probe is manually withdrawn after a slight turn, in either direction, of the large knurled locking ring on the attenuator. The probe is graduated in 10 db increments for the most useable portion of its length. There is no stop on the probe and it may be completely withdrawn from the tube.

CAUTION: When setting the attenuator, the probe must not be completely inserted in the tube while the instrument is operated at the low frequency end of the 260 to 500 mc range. The loading on the oscillator by the attenuator could cause the oscillator to stop. In this condition, the tubes will draw excessive current causing the B supply fuse (2A) to open.

8. RF Output Vernier and Power Switch "RF VERNIER — OFF MAX"

The RF output vernier allows a 1 to 3 db change in RF output from the RF output connector (7). The total output variation effected by the vernier is dependent on the frequency range being used. The power switch is turned on by the clockwise rotation of the vernier. Power is turned off in the complete counterclockwise position of the control.

9. Input Voltage Switch (115V — 230V)

The input voltage switch will allow operation of the 3200A in either the 115 V or 230 V ac range. The fuse (2) should be changed according to information under, "2. Fuse".

10. AC Input Power Connector (AC LINE)

The ac input power connector is used to connect the 3200A VHF Oscillator to the power line.

SECTION II
SPECIFICATIONS

Radio Frequency Characteristics

RF RANGE:
Total Range: 10 to 500 mc
No. Bands: 6

Band Ranges:		
10 - 18.8 mc		68 - 130 mc
18.5 - 35 mc		130 - 260 mc
35 - 68 mc		260 - 500 mc

RF ACCURACY
± 2% (after 1/2 hour warmup)

RF CALIBRATION:
Increments of less than 4%

RF STABILITY:
Short Term: ± 0.002%* (5 minutes)
Long Term: ± 0.02%* (1 hour)
Line Voltage: ± 0.001%* (5 volts)
* After 4 hour warmup, under 0.2 mw load. When frequency is changed by dial or bandswitching, sufficient time must be allowed for restabilization.

RF OUTPUT:
Maximum Power: >200 mw* (10-130 mc)
>150 mw* (130-260 mc)
> 25 mw* (260-500 mc)
* across external 50-ohm load

Range: 0 to >120 db attenuation from maximum output

Load Impedance: 50 ohms nominal

RF LEAKAGE:
Sufficiently low to permit measurements at 1 μv

Amplitude Modulation Characteristics

AM RANGE:
External: 0 to 30%

AM DISTORTION:
<1% at 30% AM

EXTERNAL AM REQUIREMENTS:
Approximately 30 volts RMS into 600 ohms for 30% AM

Pulse Modulation Characteristics

PM SOURCE: External

EXTERNAL PM REQUIREMENTS:
140 volts peak pulse into 2000 ohms for maximum power output; typically 10 volts peak (except 50 volts on 260-500 mc range) for 1 mw peak power output

Accessories

FURNISHED: None

AVAILABLE: 501B Output Cable
502B Patching Cable
506B Patching Cable
514B Output Cable
517B Output Cable

Physical Characteristics

MOUNTING:
Cabinet for bench use; adaptable for 19-inch rack mounting

FINISH:
Gray engraved panel; blue cabinet (other finishes available on special order)

DIMENSIONS: See Fig. 2

WEIGHT:

Net:	15 lbs. (6,8 Kg.)
Gross Export:	35 lbs. (15,9 Kg.)
Gross Domestic:	19 lbs. (8,6 Kg.)
Legal Export:	17 lbs. (7,7 Kg.)

Power Requirements

3200A: 105-125/210-250 volts, 50-60 cps, 30 watts

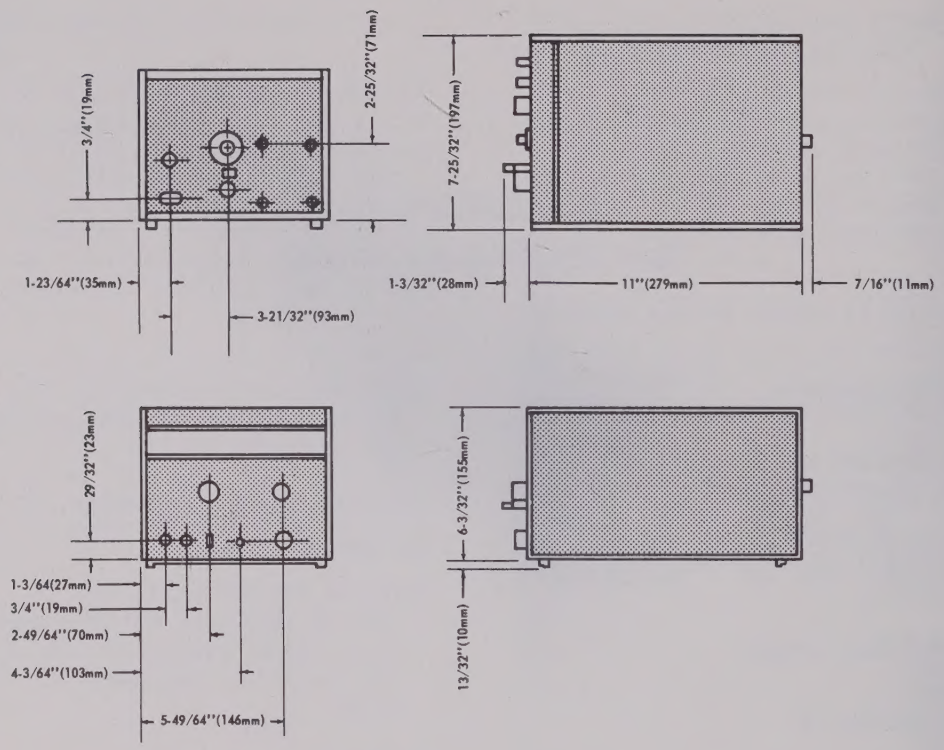


Fig. 2. 3200A Dimensions

SPECIFICATION PERFORMANCE TESTING

The following procedures provide information for a series of tests which may be performed to assure that the 3200A will meet all of the specifications given in this section. Some of the measurements have no tolerances and are subject to the accuracy of the test equipment used.

RF Characteristics

RF RANGE AND ACCURACY

EQUIPMENT REQUIRED

1. -hp- 5245L Electronic Counter

2. -hp- 5253B Frequency Converter (to increase the -hp- 5245L range to 500 mc)

3. 10 db Attenuator (to prevent overload of converter input)

TEST SETUP

1. Connect the Electronic Counter/Converter (with the 10 db attenuator) to the RF output of the 3200A, withdraw the attenuator probe to the first mark (approximately 1/2 inch), set the RF VERNIER to its maximum position, and allow a minimum of 1/2 hour warmup.

TEST PROCEDURE

1. On each frequency band, check the specified frequencies by setting the pointer on each nominal frequency shown on each band.

(a) The frequencies, as read on the Electronic Counter, must fall within the limits shown on the chart.

Nominal Frequency (mc)	*Upper Frequency Limit (mc)*	*Lower Frequency Limit (mc)*
10	10.2	9.8
18.8	19.176	18.424
18.5	18.87	18.13
35	35.7	34.3
68	69.36	66.64
130	132.6	127.4
260	265.2	254.8
500	510	490

(b) This instrument must be capable of producing all of the nominal frequencies shown with no more than 2% off-scale movement of the pointer.

RF CALIBRATION

This is a visual check of the dial calibration. The increments must be less than 4%.

Range (mc)	*Increment (mc)*	*% of Lowest Freq.*
10 to 18.8	0.2	2%
18.5 to 35	0.5	2.6%
35 to 68	1	2.8%
68 to 130	2	2.9%
130 to 260	5	3.8%
260 to 500	10	3.9%

RF STABILITY

EQUIPMENT REQUIRED

1. -hp- 5245L Electronic Counter

2. -hp- 5253B Frequency Converter (to increase the -hp- 5245L range to 500 mc)

3. -hp- 431B Power Meter with -hp- 478A Thermistor Mount

4. Variable metered power source

CAUTION: The -hp- 5253B Frequency Converter and the -hp- 431B Power Meter may be damaged by overload. Extreme care must be used when operating these instruments with the 3200A, which has a high power RF output.

TEST SETUP

1. Adjust the frequency of the 3200A to 100 mc and allow the instrument to warmup for 4 hours (line voltage set to 115 v). RF VERNIER must be in MAX position.

2. With attenuator probe withdrawn to the last calibration mark, attach the Power Meter to the RF output connector.

3. Slowly insert attenuator probe until the Power Meter reads .2 mw (—7 dbm). (This is an arbitrary value and need not be exact.)

4. Disconnect Power Meter and connect the Frequency Converter/Counter to the RF output connector.

5. Readjust the 3200A Frequency Control until the counter reads approximately 100 mc.

TEST PROCEDURE

1. Note counter reading and allow instrument to operate for 5 minutes. Note counter reading.

(a) The reading after 5 minutes should be within 0.002% of original frequency reading. At 100 mc this is ± 500 cycles.

2. After 1 hour note counter reading.
(a) The reading after 1 hour should be within .02% of original frequency reading. At 100 mc this is ± 5 kc.

3. Readjust the line voltage from 115 v to 120 v. Note counter reading.

(a) The frequency must not change by more than .001% of reading in Step 2. At 100 mc this is ± 1 kc.

RF OUTPUT

EQUIPMENT REQUIRED

1. -hp- 431B Power Meter with -hp- 478A Thermistor Mount

2. 20 db attenuator

3. 10 db attenuator

TEST SETUP

1. Connect the 20 db attenuator and power meter to the RF output connector with the 3200A attenuator near minimum output.

2. Set the 3200A range switch to the 10—18.8 mc range.

TEST PROCEDURE

1. Insert 3200A attenuator probe until power meter reads 2 mw. Check RF output across the band, readjusting 3200A attenuator probe if output drops below 2 mw.

(a) Output must be greater than 2 mw across the band. (Actual power output is greater than 200 mw.)

2. Repeat step 2 under Test Setup and step 1 above on 18.5—35 mc, 35—68 mc, and 68—130 mc ranges.

3. Set the 3200A Range Switch to the 130—260 mc range.

4. Insert 3200A attenuator probe until power meter reads 1.5 mw. Check RF output across the band, readjusting the 3200A attenuator probe if output drops below 1.5 mw.

(a) Output must be more than 1.5 mw across the band. (Actual power output is greater than 150 mw.)

5. Set the 3200A attenuator for minimum output with Range Switch in 260—500 mc range.

6. Remove the 20 db attenuator and replace it with the 10 db attenuator.

7. Insert 3200A attenuator probe until power meter reads 2.5 mw.

CAUTION: When setting the attenuator, the probe must not be completely inserted in the tube while the instrument is operated at the low frequency end of the 260 to 500 mc range. The loading on the oscillator by the attenuator could cause the oscillator to stop. In this condition, the tubes will draw excessive current causing the B supply fuse (2A) to open.

Check the output across the band, readjusting the 3200A attenuator probe if the output drops below 2.5 mw.

(a) Output must be greater than 2.5 mw across the band. (Actual power output is greater than 25 mw.)

RF OUTPUT RANGE

The range of the attenuator is specified to be 0 to greater than 120 db.

NOTE: For information regarding the testing of this specification refer to Hewlett-Packard Application Note 20 — "-hp- Signal Generator Output Attenuators".

RF OUTPUT LOAD IMPEDANCE

The internal impedance of this instrument is not specified. The specifications are based on data taken with an external 50-ohm (nominal) load impedance connected to the RF Output Connector.

RF LEAKAGE

There are no standards available at this time whereby this test can be made. It is advisable to operate the 3200A under the normal conditions for which it is to be used. The low limit of the 3200A useage can be determined. This low limit should confirm the specification given.

Amplitude Modulation Characteristics

AM RANGE AND AM DISTORTION

EQUIPMENT REQUIRED

1. Boonton 3200A
2. -hp- 130C Oscilloscope
3. High Output Audio Oscillator
4. GR 874 VR Diode Mixer
5. -hp- 410C AC VTVM
6. -hp- 330B Distortion Analyzer
7. 50-ohm termination

TEST SETUP

1. Connect the equipment as shown in Fig. 3.

2. With input to modulation terminals on 3200A temporarily disconnected, adjust the second VHF Oscillator for zero beat as observed on oscilloscope. (Use oscilloscope internal sweep for this setup.)

3. Adjust the second VHF Oscillator away from zero beat until a clean rectangle is observed (Fig. 4A).

4. Connect the audio oscillator to the modulation input terminals on the 3200A under test. Set the audio frequency between 20 cycles and 20 kc.

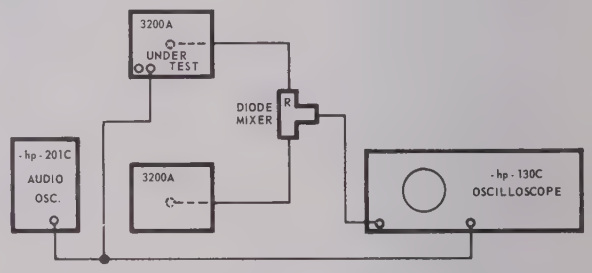


Fig. 3. AM Characteristics Setup

TEST PROCEDURE

1. Adjust the audio oscillator output to form a trapezoid which has a long vertical side of 10 oscilloscope divisions and a short vertical side of 5.39 oscilloscope divisions (Fig. 4B). (The oscilloscope pattern width is not important but must be kept within screen limits for observing sides of pattern.)

(a) At this point the RF is amplitude modulated by 30%.

2. Connect the AC VTVM across the modulation input terminals.

(a) The meter reading shall be 30 v ±7v.

3. Disconnect the 3200A used as a beat frequency oscillator and add 50-ohm termination in its place at diode mixer. Replace the oscilloscope with the distortion analyzer.

4. Measure the distortion of the recovered audio.

5. Without changing the audio oscillator setting, measure the audio oscillator distortion directly.

(a) The difference in distortion between the recovered audio frequency and the output of the audio oscillator should be less than 1%.

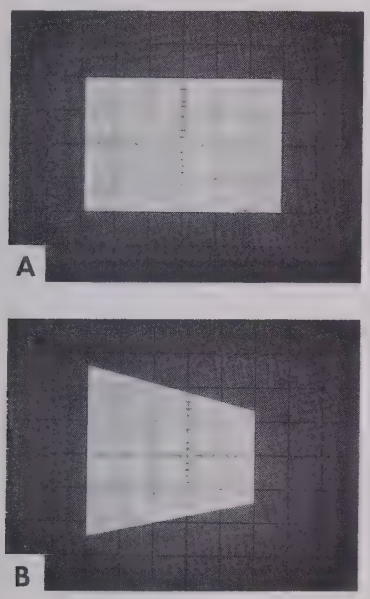


Fig. 4. AM Characteristics Oscilloscope Displays

Pulse Modulation Requirements

EXTERNAL PM REQUIREMENTS

EQUIPMENT REQUIRED

1. Boonton 8900B Peak Power Calibrator

2. Harrison Model 6207A Power Supply (0—160 vdc, 0-200 ma)

3. -hp- 130C Oscilloscope

4. 3 db Attenuator

TEST SETUP

1. Connect the equipment as shown in Fig. 5.

2. Disconnect the power supply temporarily and set the 3200A for AM/CW operation with an output frequency of 100 mc.

3. Adjust for maximum output as indicated on the oscilloscope. (Using the Peak Power Calibrator, the CW output appears as a straight line.)

4. The CW level, measured on the Peak Power Calibrator, should be greater than 100 mw. (The actual output of the 3200A will be greater than 200 mw.)

5. Connect the power supply and change the 3200A to the PULSE position.

TEST PROCEDURE

1. Increase the power supply output until the Peak Power Calibrator indicates the same CW level as in Step 4 under TEST SETUP.

2. Read the output dc voltage on the power supply meter.

(a) The dc voltage should be less than 140 vdc.

Using the same technique, the peak pulse voltage requirement for any frequency or power output, within the range of both the 3200A and the 8900B, can be determined.

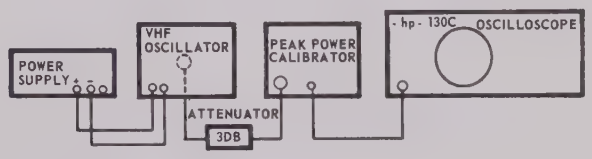


Fig. 5. PM Requirements Setup

SECTION III
OPERATING INSTRUCTIONS

OPERATING PRECAUTIONS

1. Before applying power to this instrument withdraw the attenuator probe to the first calibration mark. When setting the attenuator, the probe must not be completely inserted in the tube while the instrument is operated at the low frequency end of the 260 to 500 mc range. The loading on the oscillator by the attenuator could cause the oscillator to stop. In this condition the tubes will draw excessive current causing the B supply fuse (2A) to open.

2. For information on Ventilation, see Preventative Maintenance in Section VI.

INSTALLATION

Remove the 3200A from its shipping carton and place it in position on a test bench.

This instrument may be rack mounted after installation in a combining case (-hp- 1052A) or a Rack Adapter Frame (-hp- 5060-0797). The area not used by the instrument, in either case, may be covered by a filler panel (-hp- 5060-0794). When rack mounting this instrument, special provision must be made for access to the output connector and attenuator adjustment which are on the rear panel of the instrument.

Connect the power cord to the power socket on the rear panel of the 3200A.

Connect the power cord to a 105-125 v, 50 or 60-cycle source. An input voltage switch (9), mounted on the rear panel of the instrument, may be operated to permit use of a 105-125 or 210-250 volt, 50 or 60-cycle source.

NOTE: The 3200A VHF Oscillator was designed to operate from a 50 or 60-cycle input source. However, it will work satisfactorily at higher frequency input sources up to 1000 cycles.

Rotate the power switch to the "on" position. The 3200A is useable in less than one minute, but for specified stabilities it should warm up 4 hours.

USING THE OSCILLATOR

Output Attenuator

The output level from the 3200A is controlled by a piston attenuator. The attenuator probe is calibrated in twelve 10 db steps with no absolute values shown. The probe may be locked in any position along its length by the slight rotation of the knurled locking ring on the attenuator.

CAUTION: When setting the attenuator, the probe must not be completely inserted in the tube while the instrument is operated at the low frequency end of the 260 to 500 mc range. The loading on the oscillator by the attenuator could cause the oscillator to stop. In this condition, the tubes will draw excessive current causing the B supply fuse (2A) to open.

The attenuator probe may be completely withdrawn from the tube, so care should be taken to avoid damage.

Modulation Input

In the AM/CW position of the modulation input switch, the modulating signal is impressed on a resistor in series with the oscillator tube plate voltage supply. The polarity of the terminals is not significant and, as such, are unmarked.

In the pulse position, the B supply is disconnected and the modulating signal is effectively connected between the plates and the cathodes of the oscillator tubes. The left terminal is connected to the plate circuitry and the right terminal is connected to the cathode circuitry. Either positive-going or negative-going pulses may be used by proper connection to the instrument. Incorrect connection is evident by lack of output from the instrument.

SECTION IV
THEORY OF OPERATION

GENERAL

The 3200A VHF Oscillator, shown in the block diagram (Fig. 6) covers the frequency range from 10 to 500 mc with six overlapping bands. This instrument was designed primarily as a high output source of CW. Circuitry has been incorporated to allow both amplitude and pulse modulation. A variable, piston type, waveguide-below-cutoff attenuator is used to control the output.

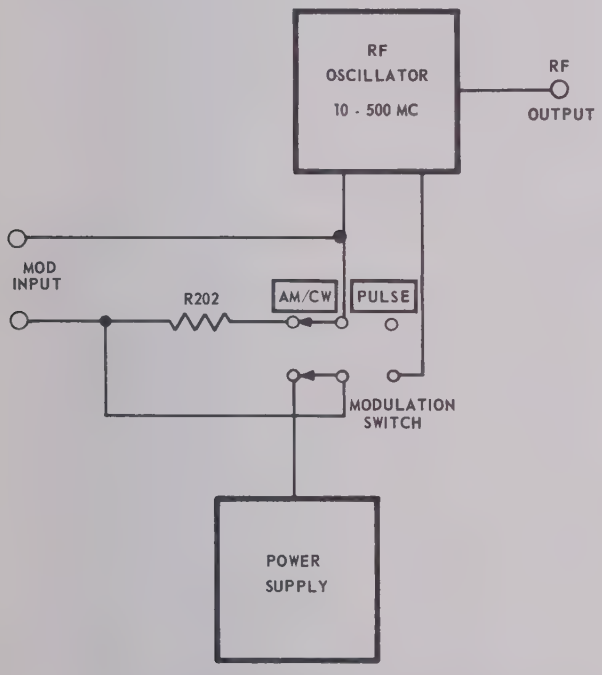


Fig. 6. Block Diagram — 3200A

RF OSCILLATOR

The oscillator circuit, shown in Fig. 7, generates all of the radio frequencies in the 10 to 500 mc range of the instrument. The circuit employs two 6DZ4 triodes with push-pull connected plates and grounded cathodes. Simple, fixed feedback is accomplished by means of capacitive dividers consisting of C102 and C104, together with the grid-to-cathode capacitance of the triodes. Chokes L109 and L110, along with good cathode grounding and short grid connections, serve to maintain high grid circuit impedance, preventing phase shift in the feedback voltage divider and consequential oscillation in the circuit at some frequencies.

Tuning of the oscillator is accomplished by means of a tank circuit which includes coils L101 and L106 and capacitors C103A and C103B. Actually, there are six different tank coils; one for each frequency range. The coils are wrapped on a specially formed turret which is detented into one of six frequency range positions by the Range Switch on the front panel. Wiping contacts are used to connect the selected coil into the tank circuit. The center of each tank coil is neutral and is used as a feed point for plate power which is connected through a switch operated by the turret drive, and a common supply ring on the turret. One hundred ohm resistors (R101 to R106) are connected between the coils and the B+ feed point to break up undesirable RF paths, without introducing appreciable plate voltage or RF loss.

ATTENUATOR

The output from the oscillator is coupled to a pickup loop (L107) mounted at the end of a piston in the waveguide-below-cutoff attenuator. The distance between the pickup coil and the output coils on the turret is a fixed amount with the probe fully inserted. With this dimension fixed on each frequency range, the coupling is different. On the high range, with the attenuator probe at maximum penetration, the pickup coil becomes overcoupled with the output coil. In some instances, this overcoupling loads the tuned output circuit to an extent which causes the oscillator to stop. With this type of attenuator setup, the maximum penetration does not mean maximum output.

MODULATION

Amplitude modulation of the 3200A is accomplished by impressing the modulating voltage across a resistor which is in series with the plate voltage supply for the oscillator tubes. This is shown in block diagram form (Fig. 8).

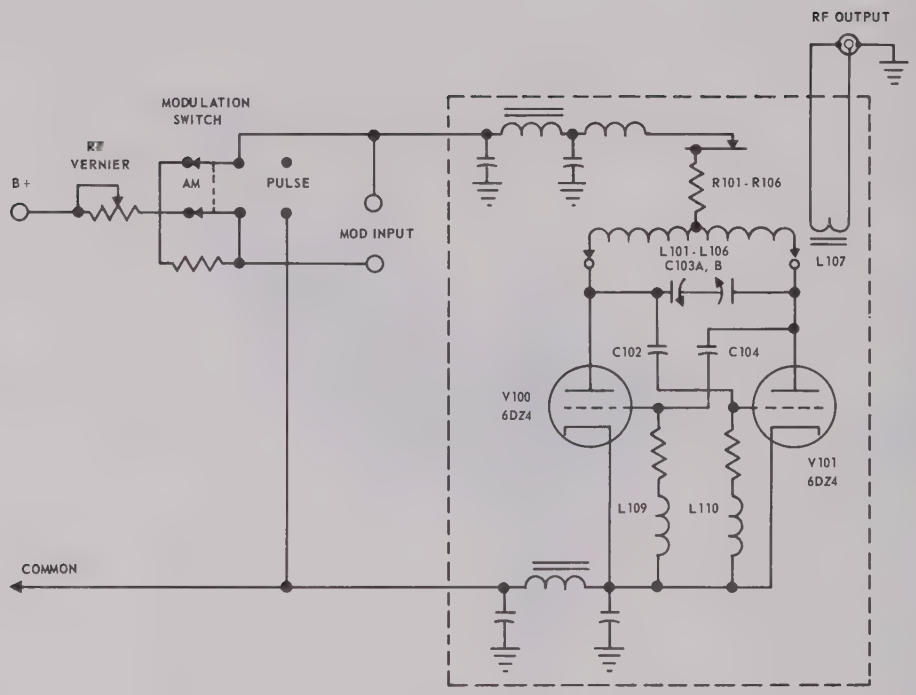


Fig. 7. RF Oscillator Circuit

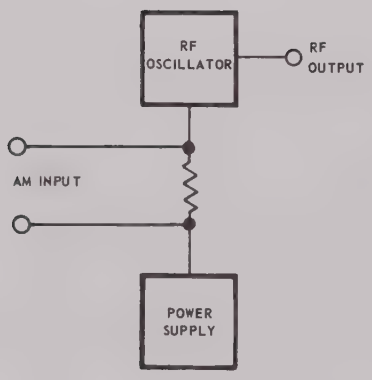


Fig. 8. Amplitude Modulation — 3200A

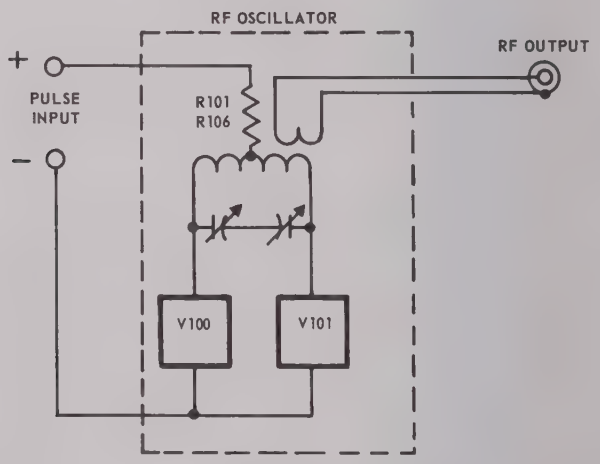


Fig. 9. Pulse Modulation — 3200A

The B— line of the power supply is not connected to the chassis, thus no high voltage dc is available at the front panel. With this type of modulation, up to 30% AM is possible with less than 1% distortion.

For pulse modulation, the power supply is disconnected by the modulation switch and the input terminals are connected as the power supply input for the oscillator, as shown in Fig. 9. The input terminals are

not connected to the chassis ground, making it possible, by proper connection, to use either positive-going or negative-going pulses to pulse modulate the 3200A. The pulses actually supply the power for the oscillator, which means that the oscillator is turned on and off. With the oscillator shut off between pulses, the on-off ratio for PM becomes very high.

POWER SUPPLY

The power supply consists of two regulated supplies having a common power transformer. The outputs are 150 vdc, 40 ma. for the oscillator tube plate supply, and 6.3 vdc, 450 ma. for the oscillator tube heater supply. A block diagram of the complete supply is shown in Fig. 10.

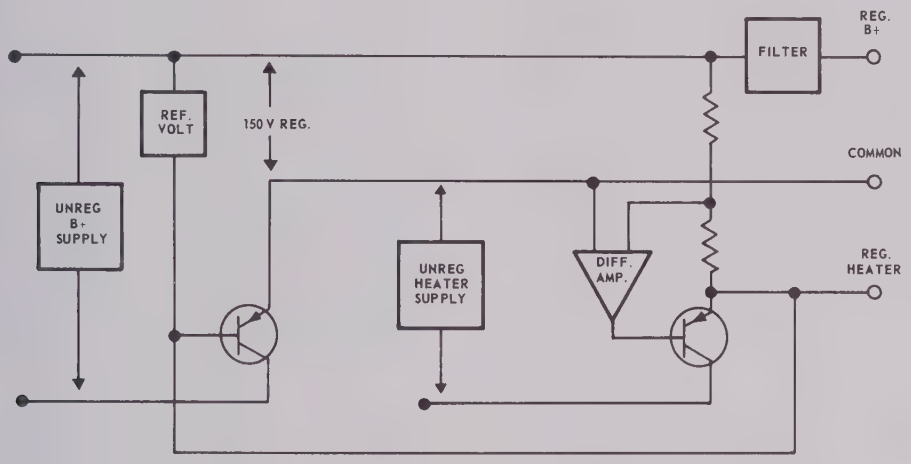


Fig. 10. Power Supply — 3200A

SECTION V
OPERATIONAL GUIDE

INTRODUCTION

The Operational Guide is a section devoted to practical application of the 3200A VHF Oscillator. This added information should assist in providing more accurate results as the capabilities and limitations of the instrument are expanded upon.

OUTPUT LEVEL

Operating efficiency in a wide-band oscillator varies across the entire band. Thus, the output power also varies. The typical maximum output over the range of the 3200A is shown in Fig. 11. The maximum output into 50-ohms has been determined by observing the output of the 3200A, while adjusting the probe, without regard to probe calibration markings.

RF DISTORTION

The basic oscillator used in the 3200A has two tubes operated in push-pull. In the normal balance condition between the tubes, the push-pull operation suppresses the even harmonic content of the output waveform.

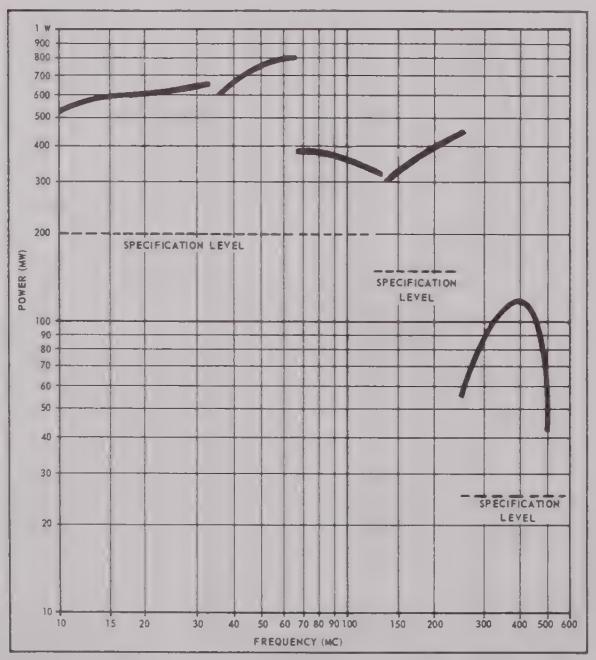


Fig. 11. Typical Maximum Power Output

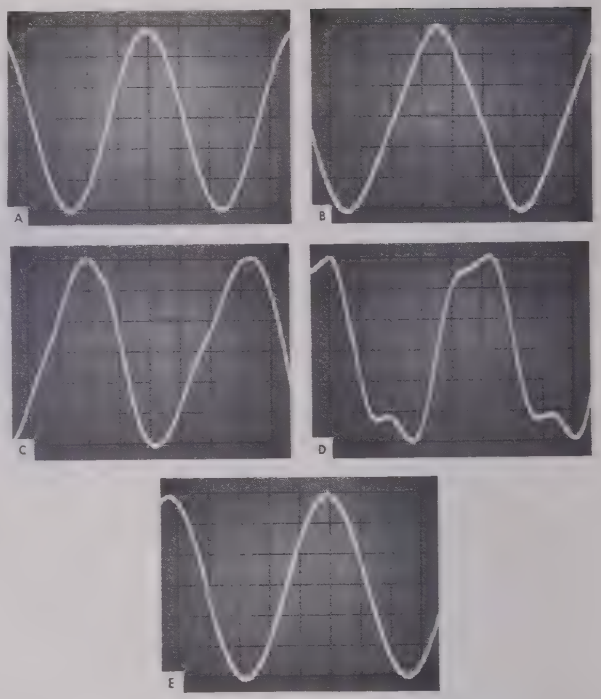


Fig. 12. Typical RF Output Waveforms

The output of the 3200A is sinusoidal with very low distortion. Using a high frequency sampling oscilloscope (such as the -hp- 185B), the RF waveform may be observed directly. The oscilloscope patterns in Fig. 12 show the typical output of the 3200A at various frequencies. Fig. 12A is the output waveform at 100 mc. Figs. 12B and 12C are RF waveforms at 400 mc and 500 mc respectively. At the higher frequencies, and at lower output levels, the waveshape departs slightly from sinusoidal as the slope of the curve through the baseline resembles a straight line. With a very low output level at 460 mc, even harmonics show up in the waveform as in Fig. 12D. This condition is due to the lack of perfect electrical balance between two tube circuits, which is normal, as lead lengths and tube and component characteristics differ slightly. At the higher output levels, and on the high frequency range, the RF waveshape again resembles the shape shown in Fig. 12A. By the use of a low-pass filter, the output waveshape may be restored to its original shape, as in Fig. 12E.

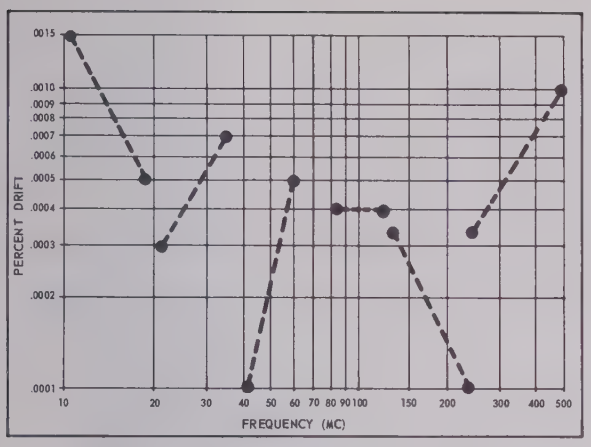


Fig. 13. Typical Frequency Drift

TYPICAL DRIFT

The output level of the 3200A is quite stable for long periods of time. However, the frequency will drift slightly. Also, after complete warmup, the frequency stability will change as a result of switching ranges or readjusting the frequency dial. Typical frequency drift (for 5 minutes after a 4-hour warmup), on the various ranges, is shown in Fig. 13. The drift is shown as a percentage of the initial frequency setting.

FREQUENCY RESPONSE (MODULATION)

The 3200A is modulated by impressing the modulating voltage across a resistor in series with the plate supply for the push-pull oscillator tubes. The modulating voltage is fed, via a low pass filter, into the RF housing. This filter must have a low cut-off frequency to prevent RF leakage at the low RF frequencies. However, the response is essentially flat across the audio range to 20 kc. Fig. 14 shows the typical frequency response with an RF frequency of 10 mc and 100 mc.

AMPLITUDE MODULATION

The 3200A can be used at higher than 30% AM. The 30% AM at less than 1% distortion (See Specifications—Section II) is a limitation because of lack of external control of the internal power supply. The design of the 3200A is such as to allow operation with an external variable dc supply. Depending on the source used, the audio signal may be transformer or capacitively coupled to the dc supply. This composite ac and dc signal is connected to the modulation input terminals with the modulation input switch in the PULSE position. The only limitation of this method of modulation is that the dc supply voltage plus the rms voltage of the modulation signal must not exceed 135 volts. (This is the tube manufacturer's design maximum). One hundred percent modulation is possible with this mode of operation. Recovered audio distortion for 90% amplitude modulation with 1 v rms RF output has been found to be typically less than 3% at 10, 20, 40, 80, 150, 250, 400, and 500 mc.

It should be noted that the RF output may not meet the specified levels with this system.

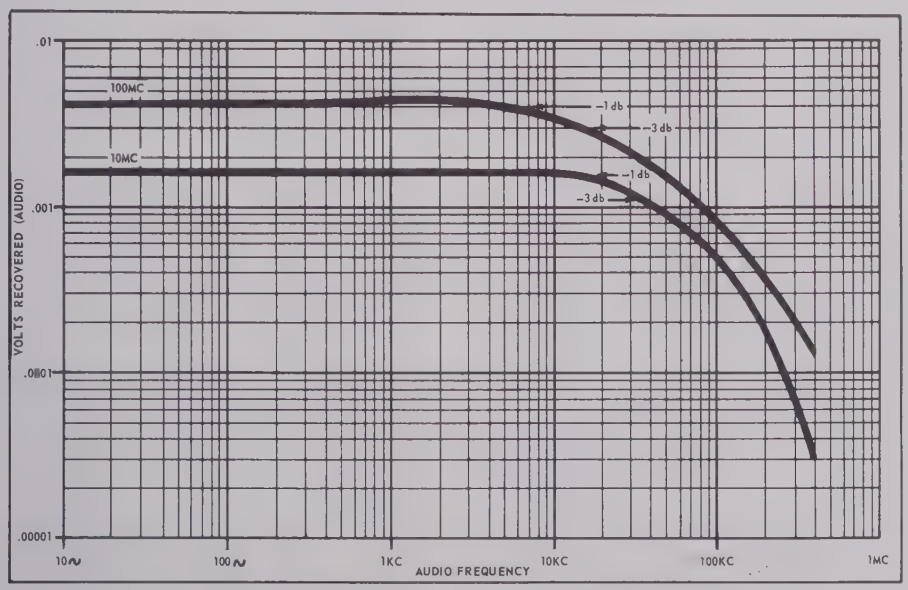


Fig. 14. Typical Frequency Response

SECTION VI
MAINTENANCE

GENERAL

The 3200A VHF Oscillator is a very compact instrument, which generally makes equipment difficult to maintain. However, by use of the disassembly procedure for trouble shooting and repair as described under Mechanical Disassembly Procedures, this instrument can be readily serviced or maintained.

PREVENTATIVE MAINTENANCE

Ventilation

The 3200A utilizes both tubes and semiconductors. Heat is dissipated through conduction and radiation of the large metal pieces which act as heat sinks. This instrument has been tested to operate satisfactorily with ambient temperatures up to 55° C (131° F). Ventilation should be provided to avoid exceeding this temperature.

Lubrication

The 3200A is adequately lubricated for the life of the instrument. Added lubrication is necessary only when lubricants are wiped off during replacement of parts. The instrument should be checked periodically. If the lubrication on the drum dial shaft or the frequency shaft becomes thick, a small amount of light oil should be added to thin the "Molykote" on the shafts. The detent roller should be inspected for lubrication at the bearing. "Molykote G" (-hp- stock number 6040-0024) or equivalent should be used on this bearing.

Transistor Insulators

Some of the transistors in this instrument are insulated electrically from the heat sink by mica. For maximum transfer of heat to the heat sink through the insulator, it is coated on both sides before assembly with silicone grease (-hp- stock number 8500-0059).

TROUBLE SHOOTING AND REPAIR

WARNING: Removing the top cover of the instrument exposes the power transformer secondary winding connections on the printed circuit board which constitutes a shock hazard if the instrument is operated in this condition.

Trouble Shooting Chart

The Trouble Shooting Chart is in the form of a trouble shooting tree. The tree shows a logical sequence to be used for determining a fault when the power output from the 3200A is too low or when there is no output. Follow each step toward the normal (T-true) or abnormal (F-false) condition as determined by indicated tests.

Tube and Semiconductor Replacement

All tubes and semiconductors are easily accessible after the 3200A is disassembled for trouble shooting and repair as described under Mechanical Disassembly Procedures.

Voltage and Resistance Chart (Fig. 25)

The Voltage and Resistance Chart indicates normal operating conditions for the VHF Oscillator while in the trouble shooting condition (RF shield removed and no load on the output). Voltages were checked with a VTVM (-hp- 410B). Resistance readings were made under the same conditions with the power disconnected. Some resistance readings were omitted as they have no significance; i.e., cases where electrolytic capacitors or semiconductor devices are connected in the circuit.

MECHANICAL DISASSEMBLY PROCEDURES

Top and Bottom Covers

1. Remove two screws at the rear of the instrument.

2. Slide cover toward the rear of the instrument to disengage lip at front panel.

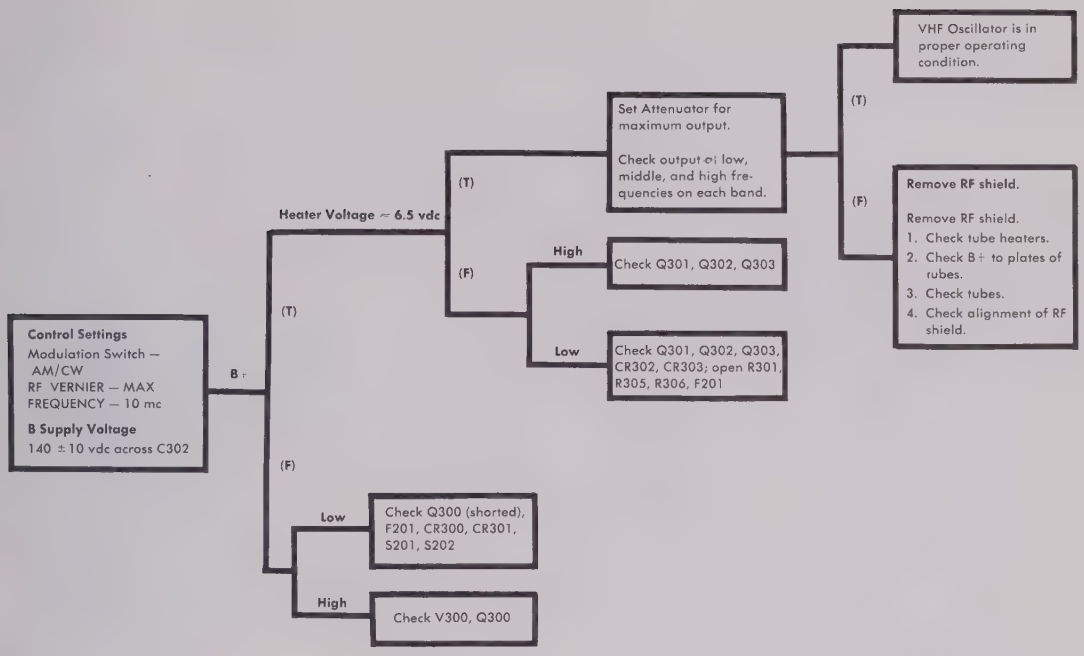
Right and Left Side Covers

Remove four screws from the side covers. Top and bottom covers need not be removed to remove side covers.

Trouble Shooting and Repair Setup (Fig. 15)

1. Remove top, bottom, and side covers.

2. At rear of instrument, remove attenuator probe. Rotate attenuator retaining ring one complete turn. Slide retaining ring off of attenuator tube.



Trouble Shooting Tree — Power Output

NOTE: Locking pin will remain in tube. During reassembly of retaining ring the pin must be pressed back in place.

3. Remove plug P200 from receptacle J200.

4. At right side of the instrument, remove the two screws retaining the rear panel and one screw retaining the printed circuit board.

5. At left side of the instrument, remove the one screw retaining the front panel switch plate, and the two screws retaining the RF base plate assembly.

6. Carefully separate the instrument into two pieces. The left side and rear panel constitute one piece. The right side and lower front panel constitute the second piece.

NOTE: Care should be taken as the upper front panel, front panel window, and window mask will be loose parts and should be removed during trouble shooting and repair procedures.

7. Remove four screws retaining the RF shield casting and slide it carefully away from the RF base plate assembly.

8. Replace P200 plug in J200 receptacle.

The 3200A is now in operating condition. The attenuator probe may be placed in approximately normal position by reversing the RF shield casting.

Front Panel Disassembly

1. Remove top, bottom, and side covers.

2. At left side of the instrument, remove the one screw retaining the front panel switch plate, two screws retaining the RF base plate assembly. At right side remove one screw retaining the printed circuit board.

3. At left side fo the instrument, loosen the two screws retaining the rear panel.

4. At right side of the instrument, remove one screw retaining the front panel switch plate.

5. Using a 5/64 inch Allen wrench, remove the two front panel control knobs.

6. Carefully separate the left side frame from the front panel.

NOTE: Care should be taken as the upper front panel, front panel window, and window mask will be loose parts and should be removed during this procedure.

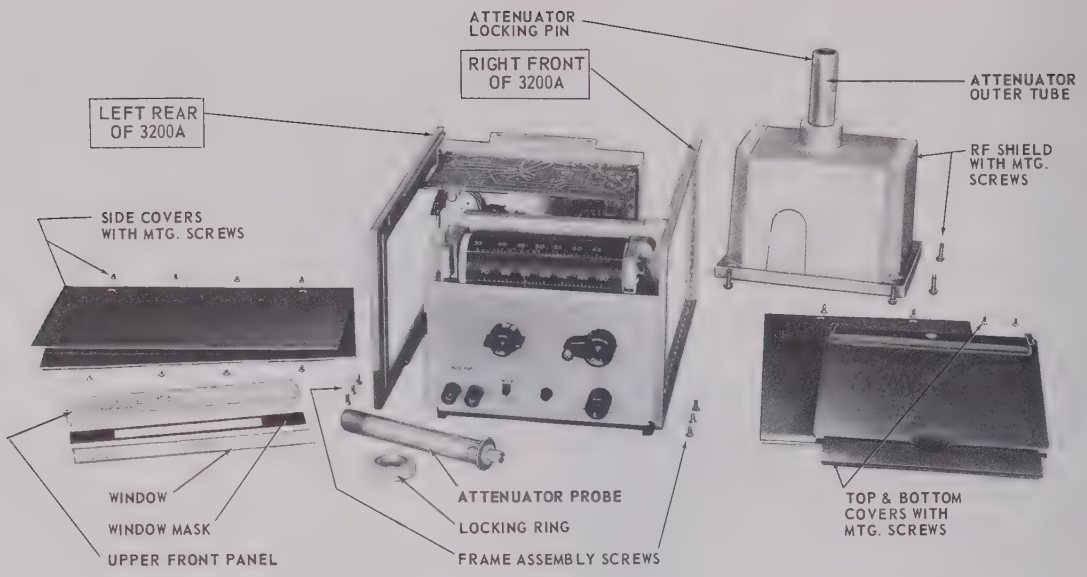


Fig. 15. Trouble Shooting and Repair Setup

7. Carefully separate the front side frame from the front panel.

The front panel will be restrained only by the wires attached.

Turret Assembly Removal

The turret assembly may be readily removed with the 3200A in the trouble shooting and repair condition. However, the turret position on the shaft is very critical and the RF frequency alignment should be checked after replacement. (See RF Calibration before removing turret).

Dial Stringing Procedure (Fig. 16)

The dial stringing should be done with the front panel disassembled, but not disconnected from the instrument.

1. Using approximately 4 feet of .027 inch diameter, nylon covered, glass core dial cord, thread about 15 inches of cord through the right side hole in the cursor.

2. Loop the cord once around pin on cursor and thread balance of cord through left side hole in cursor. (See Fig. 16.)

3. Thread the 15-inch section of cord around the small right side pulley, through the RF base plate, and around the large pulley to the "start" pin on the large pulley.

4. At this point, the notch in the large pulley should face the rear of the instrument ($\pm$ 45°), and the dial pointer should be near the 10 mc calibration mark.

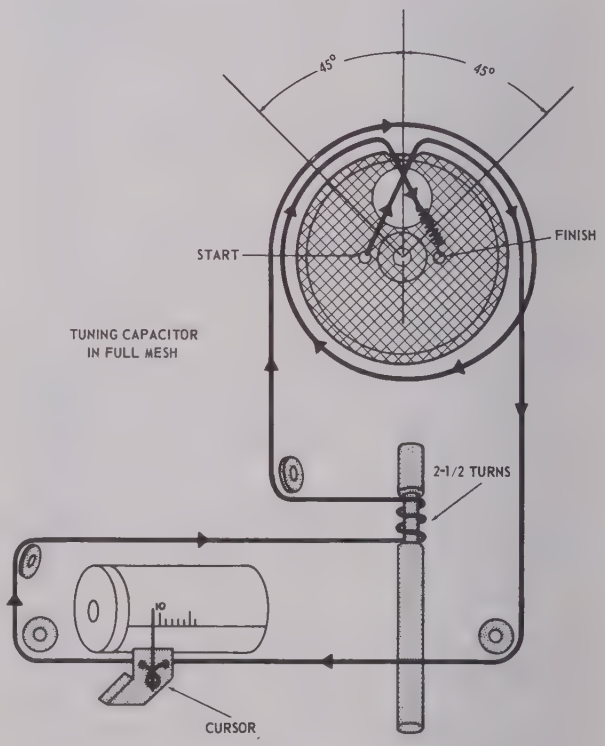


Fig. 16. Dial Stringing

Secure the dial cord on pin.

5. Thread the dial cord around the small left side pulley, the angle pulley, etc. as shown in Fig. 16.

6. Before securing the cord on the dial spring, adjust tension so as to extend spring no more than 1/8 inch.

7. The frequency control should be rotated to the extremes of the dial travel to assure proper operation.

8. With the tuning capacitor fully meshed, the dial pointer should be 1/32 to 1/16 inch to the left of the 10 mc calibration mark. Required adjustment can be made by slipping the pulley on the tuning capacitor shaft.

ADJUSTMENT AND CALIBRATION

Any tolerances listed in this section are the limits indicated by the Specifications in Section II. Factory adjustments are made to considerably closer tolerances. Field adjustments to closer than specified tolerances are possible if time and patience are used.

Recommended Equipment List

The following instruments are recommended for use in the adjustment and calibration of the 3200A VHF Oscillator. Pertinent information is given for substitution purposes.

1. -hp- 410C VTVM
   General purpose ac-dc voltmeter, dc ammeter, and ohmmeter
   Accuracy ± 2% of full scale
2. -hp- 130C Oscilloscope
   Sensitivity: 0.2 mv/cm
   Frequency Range: 0 to 500 kc
3. -hp- 5245L Frequency Counter
   Frequency Range: 0 to 50 mc
4. -hp- 5235B Frequency Converter
   Extends range of 5245L frequency counter to 500 mc.
5. -hp- 11042A Probe Coaxial "T" Connector
   For use on the -hp- 410C
6. 20 db attenuator
7. Variable, metered, power source
   Output range: 105 to 125 vac

Power Supply

EQUIPMENT REQUIRED

1. -hp- 410C VTVM or equivalent*
2. Variable, metered, power source*
3. -hp- 130C Oscilloscope or equivalent*

* *See Recommended Equipment List under Adjustment and Calibration.*

PRELIMINARY SETUP†

Connect the 3200A to the power source set to 115 v. Connect the VTVM (dc function) from junction CR305—R303 (—) and junction CR304—R304 (+) on printed circuit board.

MEASUREMENT AND ADJUSTMENT

1. Heater voltage should be 6.6 v ± 0.13 vdc. Readjust R306 (Htr Adj) if required. (6.6 v at power supply is equivalent to 6.0 v at tube socket terminals.)

2. Change input voltage to 125 v and then 105 v. Heater voltage must be within ± 2% of voltage in Step 1.

This test also checks B supply stability, as the heater voltage is referenced to the B supply voltage.

3. Disconnect the VTVM and connect the oscilloscope in its place. (The 3200A has a floating power supply. Do not connect to external ground.)

4. The ac signal on the heater line must be less than 50 mv P-P.

5. Change the oscilloscope connections to points across capacitor C302.

6. The ac signal on the B supply line must be less than 20 mv P-P.

7. Disconnect the oscilloscope and connect the VTVM between "B" common and pin #1 or #5 of V300.

8. The B supply voltage should be 150 v ± 10 v.

RF Calibration Including Turret

Reassembly Procedures

After the original factory calibration, the only reason for recalibration would be as a result of replacing the turret, a critical component mounted on the tube shelf, or the complete tube shelf assembly.

Before attempting turret disassembly or frequency calibration, the following information should be noted:

1. The original turret may be removed and replaced without complete calibration, if it is replaced as precisely as possible in its original position on the shaft. A scribe mark on the shaft can be used as a guide for position along the shaft. The turret contacts should be centered on the capacitor contacts.

2. The position of the turret along the shaft is restricted by the ability of the turret to operate switch

† *See trouble shooting and repair setup under Mechanical Disassembly Procedures.*

S101 on the two lower frequency ranges; also the ability of the turret tuned circuit on the 260 to 500 mc range to allow the instrument to tune the range required.

3. The normal mechanical tolerances of the holes used for mounting the RF shield casting is such as to affect the calibration. Shifting the casting slightly will change frequency and output power slightly so the correct position should be checked electrically.

4. The attenuator probe must be properly oriented with respect to the turret. Changing the turret could result in mechanical interference. See attenuator adjustment under Calibration, Steps 7, 8, and 9.

5. There is circuitry in the 3200A used to suppress paracitics. C108 is the only adjustable component which serves this purpose. The other circuitry is not adjustable but is controlled by component position and lead length. If replacement is required, these parts should be replaced as close as possible to their original position.

The suppressor circuits consist of:

a. C117 and R110
b. C118 and R115
c. C119, R111, and R112
d. C120, C108*, R109, and L108
e. C121 and R114

** See adjustment under Calibration, Step 2.*

6. The calibration of this instrument can be performed with the RF shield removed and the attenuator probe supported in a position approximately 1/2" from the turret simulating its normal position. Replacing the RF shield will increase the frequency by nominally 1%. For increased accuracy, the instrument should be checked with the shield in place.

7. If the overall calibration of the 3200A is off by approximately the same amount and in the same direction (either too high or too low) the pulley on the tuning capacitor may be slipped on the shaft to compensate for the error.

8. Changing tubes or normal aging of components in the 3200A should not require complete recalibration of the instrument. Typically the change in frequency is within the normal tolerance specified for the 3200A.

TURRET REASSEMBLY

1. Set range switch to the 10—18.8 mc range.

2. Slide the turret on the shaft such that the turret contacts do not touch the capacitor contacts while moving turret along the shaft.

3. Rotate the turret until the turret contacts are centered on the capacitor contacts, and tighten set screws enough to hold turret in place.

4. On the lower two ranges switch S101 must be operated by the cam on the turret.

5. Change range switch to the 260—500 mc range and check end frequencies (260 and 500 mc) using a frequency counter.

a. If an original turret is being reassembled, the range should be correct but the dial settings may be off (either too high or too low). In this case the turret may be moved closer to the front of the instrument to increase the output frequencies or toward the rear to decrease the frequencies. Only a few thousandths of an inch movement will be required.

b. If a new turret is being assembled on the shaft, the new turret should be set as closely as possible to the original turret position and the calibration procedure used for adjustment.

6. Check the other five ranges to assure proper calibration. (See calibration procedure for adjustment, if required.)

EQUIPMENT REQUIRED

1. -hp- 5245L Frequency Counter or equivalent*

2. -hp-5253B Frequency Converter

3. -hp- 410C VTVM or equivalent*

4. -hp- 11042A Probe Coaxial "T" Connector or equivalent*

5. 20 db Attenuator (to protect the counter from higher than specified voltages)

NOTE: The recommended VTVM is a 2% instrument as it is required for the power supply adjustment.

PRELIMINARY SETUP†

1. The RF shield cover should be reversed so it may be used to hold the attenuator probe in a somewhat normal position about 1/2 inch from the turret.

2, Connect the equipment as shown in Fig. 17.

** See Recommended Equipment List under Adjustment and Calibration.*

† See trouble shooting and repair setup under Mechanical Disassembly Procedures.

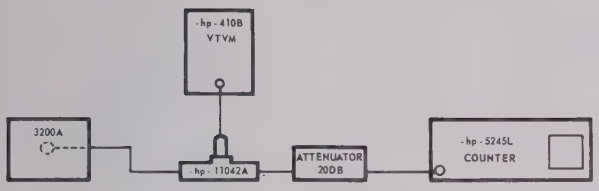


Fig. 17. RF Calibration Setup

CALIBRATION

1. Set the range switch to the 260—500 mc range. Check frequency at 260 and 500 mc. The counter should read within ± 2% of dial setting. If not, adjust the inductance of the inductor for this range by adding or removing solder from the slots in the inductor. For a small change in the inductance, the turret may be moved along the shaft.

a. Move the turret away from the RF tube shelf to increase the inductance in the capacitor contacts. This effectively reduces stray capacitance between the turret and the tube shelf.

b. Move the turret toward the RF tube shelf to decrease the inductance in the capacitor contacts. This increases the stray capacitance between the turret and the tube shelf.

2. At 260 mc adjust the attenuator probe for maximum output. This should be 25 mw (approx. 1.1 v on the VTVM assuming ideal conditions). Adjust C108 for maximum output as read on the VTVM.

3. Change to the 130—260 mc range. Check 130 and 260 mc frequencies. The counter should read within ± 2% of dial settings. If not, adjust inductance by bending coils to increase or decrease inductance.

4. The four lower frequency ranges should be checked and inductances adjusted, by means of the ferrite core in each inductor.

NOTE: If any of these coils required adjustment the coils should be recoated with Communications Products Co—Q-max A-27 and the turret baked for 1 hour at 100° C.

5. Replace the RF shield cover and the attenuator. The four mounting screws should be adjusted so as to exert equal pressure at each screw. Do not replace locking ring on attenuator.

6. Change to the 260 to 500 mc range. At 260 and 500 mc, check power output by adjusting probe for maximum in each position. Rotate the probe to assure the correct position as determined by the locking pin. The power output should be greater than 25 mw. Replace attenuator locking ring.

NOTE: Low output could be a result of weak tubes or improperly adjusted attenuator. Change tubes before adjusting the attenuator.

7. If the attenuator requires adjustment, the attenuator retaining nut inside the RF shield and the two set screws outside the RF shield will have to be loosened. This adjustment is quite critical and trials with only small movements of the attenuator tube should be attempted.

8. After attenuator adjustment, the range switch should be rotated slowly and carefully with the attenuator probe at maximum penetration to make sure there is no mechanical interference between the probe and the turret.

9. Check power output on all ranges. The power output must be greater than:

a. 200 mw (3.2 v across external 50Ω) on the 10—18.8 mc, 18.5—35 mc, 35—68 mc, and 68—130 mc ranges.

b. 150 mw (2.7 v across external 50Ω) on the 130—260 mc range.

c. 25 mw (1.1 v across external 50Ω) on the 260—500 mc range.

For more accurate measurement of the output power the -hp- 431B Power Meter (or equivalent) with an -hp- 478A Thermistor Mount is recommended in addition to a low VSWR 20 db attenuator.

SECTION VII
REPLACEMENT PARTS

GENERAL

This section includes a Reference Designation Index and a Table of Replaceable Parts. The Reference Designation Index lists all of the replaceable electrical parts in *circuit reference* order, the circuit reference being keyed to the schematic diagram. The Table of Replaceable Parts includes all replaceable parts, both electrical and mechanical, listed in numerical order by Boonton stock number. This table also includes manufacturer and recommended spares information.

Replaceable parts are identified in Figs. 18 through 24.

LIST OF MANUFACTURERS

Code	Manufacturer
01121	Allen-Bradley Co.
07115	Corning Glass Works, Electronic Comp. Dept.
14655	Cornell-Dublier Elec. Corp.
42190	Muter Co.
70903	Belden Mfg. Co.
71400	Bussmann Fuse Div. McGraw-Edison Co.
71590	Centralab Div. Globe Union Inc.
71785	Cinch Mfg. Co.
72982	Erie Resistor Corp.
73734	Federal Screw Products Co.
78553	Tinnerman Products, Inc.
79136	Waldes Kohinoor, Inc.
87930	Tower Mfg. Corp.
91506	Augat Bros, Inc.
98291	Sealectro Corp.
AMA	Amatom
Glenco	Glenco Corp.
IGC	General Ceramic Div., Indiana General Corp.
UST	U. S. Terminals
WCI	Weckesser Co., Inc.

REFERENCE DESIGNATION INDEX

CIRCUIT REFERENCE	STOCK NO.	DESCRIPTION
AT100	03200-60011	Attenuator Probe
C101	03200-00005	Trimmer, Minimum "C"
C102	0160-0388	Capacitor, Fixed: 10pf, ±10%, 500 VDCW
C103A, B	0121-0101	Capacitor, Variable: 3.5pf — 31.5pf
C104		Same as C102
C105		Same as C101
C106, 107	0160-0919	Capacitor, Fixed: 10pf, ±10%, 150 VDCW
C108	0132-0002	Capacitor, Variable: trimmer 0.7 — 3.9pf
C109-111	0160-0480	Capacitor, Fixed: 1000pf, +80—20%, 500 VDCW
C112-114	0160-0345	Capacitor, Fixed: Feedthru, 1000pf, +80—20%, 500 VDCW
C115	0160-0472	Capacitor, Fixed: 4700pf, ±20%, 1000 VDCW
C116	0150-0013	Capacitor, Fixed: .01μf, +100—20%, 500 VDCW
C117		Part of 03200-60024 Pulley Cap Assembly—not replaceable
C118	0340-0098	Terminal Standoff
C119-121		Capacitor, Special: not replaceable

REFERENCE DESIGNATION INDEX (CONT'D)

CIRCUIT REFERENCE	STOCK NO.	DESCRIPTION
C300	0180-0296	Capacitor, Fixed: Electrolytic, 40μf, 250 VDCW
C301	0170-0040	Capacitor, Fixed: Mylar, 0.047μf, ±10%, 200 VDCW
C302	0180-0295	Capacitor, Fixed: Electrolytic, 40μf, 150 VDCW
C303	0180-0345	Capacitor, Fixed: Electrolytic, 2000μf, 25 VDCW
C304	0170-0024	Capacitor, Fixed: 0.022μf, ±20%, 200 VDCW
C305	0140-0054	Capacitor, Fixed: mica, 100pf, ±10%, 500 VDCW
CR300, 301	1901-0029	Diode, Silicon: 600 PIV, 0.5A
CR302-305	1901-0049	Diode, Silicon: 50 PIV, 0.5A
DS200	1450-0048	Light, Indicator
F200	2110-0008	Fuse, Cartridge: 1/2A, 250V, SLO BLO
	2110-0018	Fuse, Cartridge: .25A, 125V, SLO BLO
F201	2110-0040	Fuse, Cartridge: 1/16A, 250V, SLO BLO
J100		Part of AT100
J200	1251-0043	Connector, Female: 8 contacts, Polarized
J201, 202	5060-0635	Binding Post: Black
L101-106		Coil, Turret: Part of Z100
L107		Part of AT100
L108		Coil, RF: Special
L109, 110	03200-80002	Choke: 80μh
L112		Same as L109
L113	03200-80001	Choke: 17μh
L114-116	00225-80001	Coil, RF
P200	1251-0133	Connector, Male: 8 contacts, polarized
P204	1251-0148	Connector: AC power cord receptacle
Q300	1850-0098	Transistor: PNP
Q301	1850-0070	Transistor: 2N1373, PNP
Q302	1850-0062	Transistor: PNP
Q303	1850-0038	Transistor: PNP
R101-106	0686-1015	Resistor, Fixed: Comp., 100 ohms, ±5%, 1/2W
R107, 108	0686-2235	Resistor, Fixed: Comp., 22K ohms, ±5%, 1/2W
R109	0683-3315	Resistor, Fixed: Comp., 330 ohms, ±5%, 1/4W
R110-112	0683-1015	Resistor, Fixed: Comp., 100 ohms, ±5%, 1/4W
R113	0686-2205	Resistor, Fixed: Comp., 22 ohms, ±5%, 1/2W
R114		Same as R110
R115	0686-0335	Resistor, Fixed: Comp., 3.3 ohms, ±5%, 1/2W
R116	0686-4705	Resistor, Fixed: 47 ohms, ±5%, 1/2W
R117	0686-5615	Resistor, Fixed: 560 ohms, ±5%, 1/2W
R201	0686-6835	Resistor, Fixed: Comp., 68K ohms, ±5%, 1/2W
R202	0698-0031	Resistor, Fixed: 680 ohms, ±10%, 2W

REFERENCE DESIGNATION INDEX (CONT'D)

CIRCUIT REFERENCE	STOCK NO.	DESCRIPTION
R203	2100-1461	Resistor, Variable: 1K ohm, 2W, with switch S200
R204	0698-0029	Resistor, Fixed: 330 ohms, ±10%, 2W
R300		Same as R101
R301	0686-7535	Resistor, Fixed: Comp., 75K ohms, ±5%, 1/2W
R302	0698-0030	Resistor, Fixed: 510 ohms, ±5%, 2W
R303	0686-6815	Resistor, Fixed: 680 ohms, ±5%, 1/2W
R304	0686-4725	Resistor, Fixed: Comp., 4.7K ohms, ±5%, 1/2W
R305	0686-2725	Resistor, Fixed: Comp., 2700 ohms, ±5%, 1/2W
R306	2100-0154	Resistor, Variable: 1K ohm, ±30%, 0.15W
R307	0686-3315	Resistor, Fixed: 330 ohms, ±5%, 1/2W
R308	0686-6825	Resistor, Fixed: Comp., 6800 ohms, ±5%, 1/2W
R309	0686-1215	Resistor, Fixed: 120 ohms, ±5%, 1/2W
S101	03200-00010	Switch: Contact Grid
S200		Part of Resistor R203
S201	3101-0033	Switch, Slide: DPDT
S202	3101-0011	Switch, Slide: DPDT
T200	9100-0314	Transformer, Power
V100, 101	1921-0034	Tube: 6DZ4
V300	1940-0004	Tube: OA2
W200	8120-0078	Power Cord
Z100	03200-60004	Turret Assembly
Z300	03200-60001	Printed Circuit Board (with components)

TABLE OF REPLACEABLE PARTS

STOCK NO.	DESCRIPTION	MFG.	MFG. PART NO.	TQ.	RECOMMENDED SPARES	
					RUNNING	1 YR.
0121-0101	Capacitor, Variable: 3.5pf —31.5pf			1		1
0132-0002	Capacitor, Variable: trimmer, 0.7—3.0pf			1		1
0140-0054	Capacitor, Fixed: Mica, 100pf, ±10%, 500 VDCW			1		1
0150-0013	Capacitor, Fixed: .01μf, +100—20%, 500 VDCW	72982	821	1		1
0160-0345	Capacitor, Fixed: Feedthru, 1000pf, +80—20%, 500 VDCW	01121	FB2B-102W	3		1
0160-0388	Capacitor, Fixed: 10pf, ±10%, 500 VDCW	07115	CYFM10C 100-K	2		2
0160-0472	Capacitor, Fixed: 4700pf, ±20%, 1000 VDCW	71590	DD472	1		1
0160-0480	Capacitor, Fixed: 1000pf, +80—20%, 500 VDCW	01121	FA5C	3		2
0160-0919	Capacitor, Fixed: 10pf, ±10%, 150 VDCW	Glenco	TC-150-C-10-K	2		1
0170-0024	Capacitor, Fixed: 0.022μf, ±20%, 200 VDCW			1		1
0170-0040	Capacitor, Fixed: Mylar, 0.047μf, ±10%, 200 VDCW			1		1
0180-0295	Capacitor, Fixed: Electrolytic, 40μf, 150 VDCW	14655	BR-40-150V	1		1
0180-0296	Capacitor, Fixed: Electrolytic, 40μf, 250 VDCW	14655	BR-40-250V	1		1
0180-0345	Capacitor, Fixed: Electrolytic, 2000μf, 25 VDCW	14655	BR-2000-25V	1		1
0340-0098	Terminal Standoff (Used as C118)	UST	G-4777-10	1		
0340-0105	Feedthru	98291	FT-SM-5	3		
0370-0026	Knob			1		
0370-0050	Handle, Knob			1		
0370-0112	Knob			1		
0370-0149	Knob			1		
0510-0111	Clip, Push on			4		
0510-0123	Nut, Tinnerman			1		
0510-0221	Nut, Tinnerman			4		
0510-0228	Ring, Retaining	79136	5133-25	1		
0510-0235	Ring, Retaining	79136	5133-37	1		
0510-0292	Clip, Tinnerman	78553	C114-632-1	3		
0510-0717	Clamp, Cable	WCI	7/16-FE	1		
0590-0107	Nut, Attenuator Retaining	77122	RL114	1		

TABLE OF REPLACEABLE PARTS (CONT'D)

STOCK NO.	DESCRIPTION	MFG.	MFG. PART NO.	TQ.	RECOMMENDED SPARES	
					RUNNING	1 YR.
0683-1015	Resistor, Fixed: Comp., 100 ohms, ±5%, 1/4W	01121	CB-1015	4		2
0683-3315	Resistor, Fixed: Comp., 330 ohms, ±5%, 1/4W	01121	CB-3315	1		1
0686-0335	Resistor, Fixed: Comp., 3.3 ohms, ±5%, 1/2W	01121	EB-0335	1		1
0686-1015	Resistor, Fixed: Comp., 100 ohms, ±5%, 1/2W	01121	EB-1015	7		2
0686-1215	Resistor, Fixed: 120 ohms, ±5%, 1/2W	01121	EB-1215	1		1
0686-2205	Resistor, Fixed: Comp., 22 ohms, ±5%, 1/2W	01121	EB-2205	1		1
0686-2235	Resistor, Fixed: Comp., 22K Ohms, ±5%, 1/2W	01121	EB-2235	2		1
0686-2725	Resistor, Fixed: Comp., 2700 ohms, ±5%, 1/2W	01121	EB-2725	1		1
0686-3315	Resistor, Fixed: 330 ohms, ±5%, 1/2W	01121	EB-3315	1		1
0686-4705	Resistor, Fixed: 47 ohms, ±5%, 1/2W	01121	EB-4705	1		1
0686-4725	Resistor, Fixed: Comp., 4.7K ohms, ±5%, 1/2W	01121	EB-4725	1		1
0686-5615	Resistor, Fixed: 560 ohms, ±5%, 1/2W	01121	EB-5615	1		1
0686-6815	Resistor, Fixed: 680 ohms, ±5%, 1/2W	01121	EB-6815	1		1
0686-6825	Resistor, Fixed: Comp., 6800 ohms, ±5%, 1/2W	01121	EB-6825	1		1
0686-6835	Resistor, Fixed: Comp., 68K ohms, ±5%, 1/2W	01121	EB-6835	1		1
0686-7535	Resistor, Fixed: Comp., 75K ohms, ±5%, 1/2W	01121	EB-7535	1		1
0698-0029	Resistor, Fixed: 330 ohms, ±10%, 2W	07115	C-42	1		1
0698-0030	Resistor, Fixed: 510 ohms, ±5%, 2W	07115	C-42S	1		1
0698-0031	Resistor, Fixed: 680 ohms, ±10%, 2W	07115	C-42	1		1
1200-0116	Socket, Transistor	91506	8038-1G1	2		
1251-0043	Connector, Female: 8 contacts, Polarized	71785	261-32-08-010	1		
1251-0133	Connector, Male: 8 contacts, polarized	71785	261-31-08-031	1		
1251-0148	Connector: AC power cord receptacle	87930	H-1061-2	1		

TABLE OF REPLACEABLE PARTS (CONT'D)

STOCK NO.	DESCRIPTION	MFG.	MFG. PART NO.	TQ.	RECOMMENDED SPARES	
					RUNNING	1 YR.
1400-0084	Fuseholder	75915	342014	2		
1450-0048	Light, Indicator			1	1	1
1460-0154	Spring, Dial Cord			1	1	1
1460-0209	Spring, Leaf			1		
1490-0032	Stand, Half Module, Tilt			1		
1530-0061	Insert, Threaded: Phenolic impregnated paper			4		
1850-0038	Transistor: 2N554, PNP			1	1	1
1850-0062	Transistor, 2N404, PNP			1	1	1
1850-0070	Transistor, 2N1373, PNP			1	1	1
1850-0098	Transistor: 2N458, PNP			1	1	1
1901-0029	Diode, Silicon: 600 PIV, 0.5A			2	2	4
1901-0049	Diode, Silicon: 50 PIV, 0.5A			4	4	4
1921-0034	Tube: 6DZ4			2	4	4
1940-0004	Tube: 0A2			1	1	1
2100-0154	Resistor, Variable: 1K ohm, ±30%, 0.15W			1		1
2100-1461	Resistor, Variable: 1K ohm, 2W, with switch S200			1		1
2110-0008	Fuse, Cartridge: 1/2A, 250V, SLO BLO	71400	MDL 1/2	1	10	10
2110-0018	Fuse, Cartridge: .25A, 125V, SLO BLO	71400	MDL 1/4	1	10	10
2110-0040	Fuse, Cartridge: 1/16A, 250V, SLO BLO	71400	MDL 1/16	1	10	10
2190-0047	Lockwasher, Conical			13		
2190-0109	Washer, Shoulder	73734	104002	2		
2190-0110	Washer, Insulating	AMA	1252	2		
2370-0016	Screw, Machine: #6-32 x 5/16", FH, Phil. Drive			16		
2370-0020	Screw, Machine: #6-32 x 3/16", FH Phil. Drive			8		
2680-0026	Screw, Nylon: #10-32 x 3/4" lg. (Tube Shelf to Baseplate)			2		
3050-0272	Washer, Spring			1		
3050-0316	Washer, Spring			3		
3101-0011	Switch, Slide: DPDT	42190	4603	1		1
3101-0033	Switch, Slide: DPDT	42190	4633	1		1

TABLE OF REPLACEABLE PARTS (CONT'D)

STOCK NO.	DESCRIPTION	MFG.	MFG. PART NO.	TQ.	RECOMMENDED SPARES	
					RUNNING	1 YR.
5000-0703	Cover, Side			2		
5000-0717	Cover, Bottom			1		
5000-3001	Spring, Detent			1		
5040-0146	Insulator, Binding Post			2		
5040-0147	Insulator, Binding Post			3		
5040-0700	Hinge			2		
5040-1601	Detent Wheel: Nylon			1		
5060-0635	Binding Post: Black			2		2
5060-0703	Frame Assembly			2		
5060-0720	Cover, Top			1		
5060-0728	Foot Assembly			2		
6040-0024	Grease, Lubricating (Molykote "G") for mechanical lubrication as specified in Section VI — Maintenance					
8120-0078	Power Cord	70903	KH-4147	1	1	1
8150-0748	Gasket, Attenuator			1	1	1
8160-0021	Gasket, Cover: approx. 22 inches required			1		1
8160-0050	Cord, Dial: 4 feet required			1	1	1
8500-0059	Compound, Silicon: 8 oz. tube; used on transistor insulators as specified in Section VI — Maintenance			1		1
9100-0314	Transformer, Power			1		1
9170-0123	Slug, Ferrite Tuning: L101 to L104	IGC	F610	4		1
00202-20034	Spacer: 3/4" lg. (J200)			2		
00202-80012	Washer, Mica: Transistor			2	2	2
00225-80001	Coil, RF			3		
00225-80007	Nut, Silver Plated			4		
00230-20065	Roller, Detent			1		
03200-00002	Panel, Upper Front			1		
03200-00003	Panel, Lower Front			1		
03200-00005	Trimmer: Minimum "C"			2		
03200-00009	Washer, Attenuator Gasket			1		
03200-00010	Switch: Contact Grid			1		
03200-00017	Contact, Upper			1		
03200-00018	Contact, Lower			1		
03200-00023	Support, Upper Panel			1		

TABLE OF REPLACEABLE PARTS (CONT'D)

STOCK NO.	DESCRIPTION	MFG.	MFG. PART NO.	TQ.	RECOMMENDED SPARES	
					RUNNING	1 YR.
03200-20003	Shield, Cover			1		
03200-20007	Countershaft			1		
03200-20008	Guide Rod, Cursor			2		
03200-20009	Ring, Locking: Attenuator			1		1
03200-20011	Shaft, Turret			1		
03200-20013	Shaft, Dial			1		
03200-20014	Window, Front Panel			1		1
03200-20015	Trim Extrusion, Front Panel			2		
03200-20019	Pin, Attenuator Locking			1		1
03200-20022	Spacer, Tube Shelf: Long			2		
03200-20023	Spacer, Tube Shelf: Short			2		
03200-20024	Spacer, Turret Shaft			1		
03200-20025	Gear, Spur: 62 Teeth, Nylon			2		
03200-20026	Gear, Bevel: 24 Teeth, Nylon, (Turret Shaft)			1		
03200-20027	Gear, Bevel: 24 Teeth, Nylon, (Countershaft)			1		
03200-20034	Shaft, Frequency			1		
03200-60001	Printed Circuit Board (with components)			1		1
03200-60003	RF Tube Shelf Assembly			1		1
03200-60004	Turret Assembly			1		1
03200-60008	Panel, Rear			1		
03200-60009	Printed Circuit Board: includes board, heat-sink, transistor sockets, and mounting brackets			1		
03200-60011	Attenuator Probe			1		1
03200-60012	Contact Assembly: B+			1		
03200-60017	Cursor Assembly			1		
03200-60018	Pulley and Bracket Assembly			3		
03200-60019	Pulley and Bracket Assembly			1		
03200-60024	Pulley Assembly: includes capacitor C117			1		1
03200-80001	Choke: 17μh			1		
03200-80002	Choke: 80μh			3		1
03200-80010	Socket, Tube			2		
03200-80014	Stop, Cursor: Left			1		
03200-80016	Mask, Window			1		
03200-80020	Drum Dial			1		

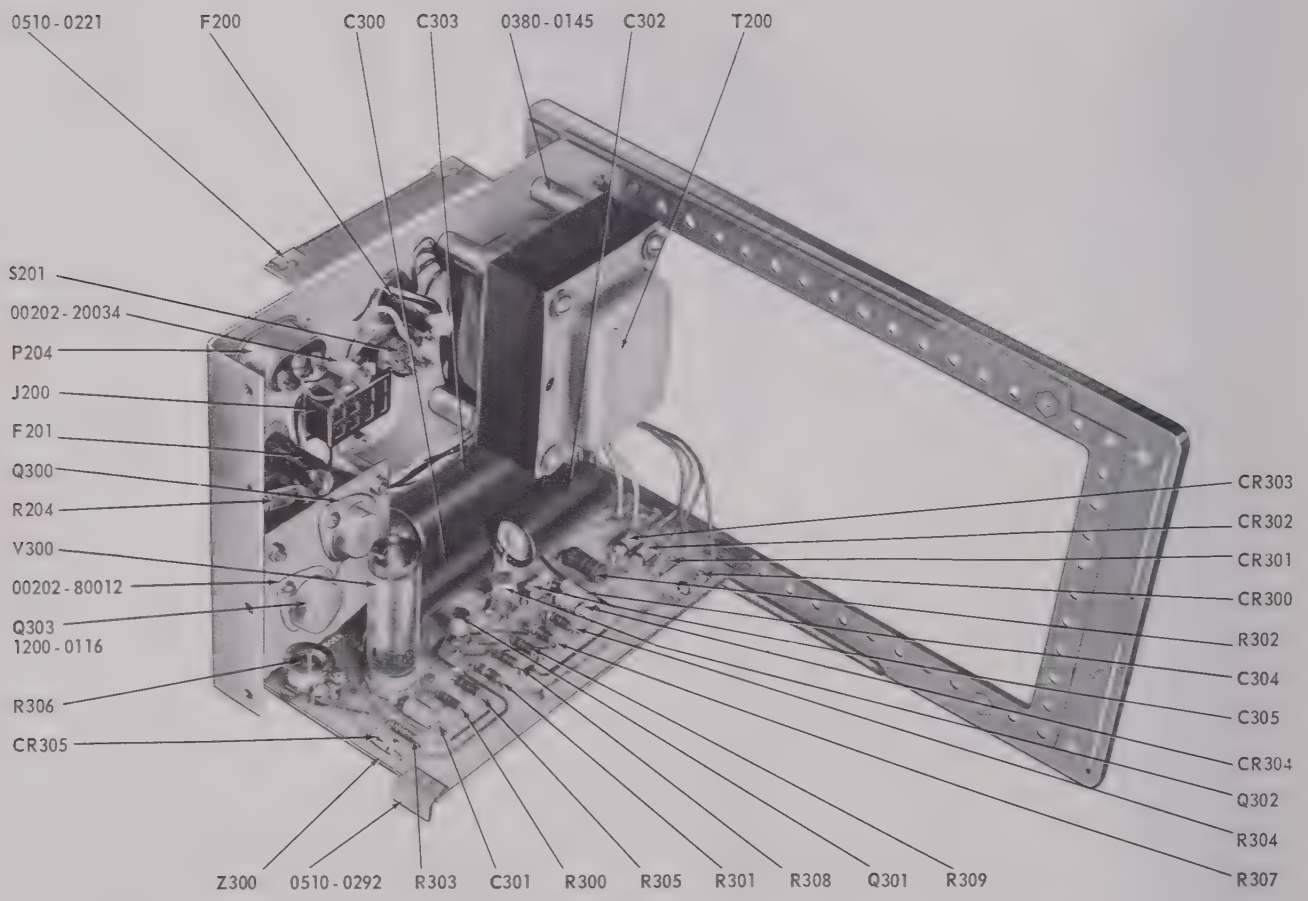
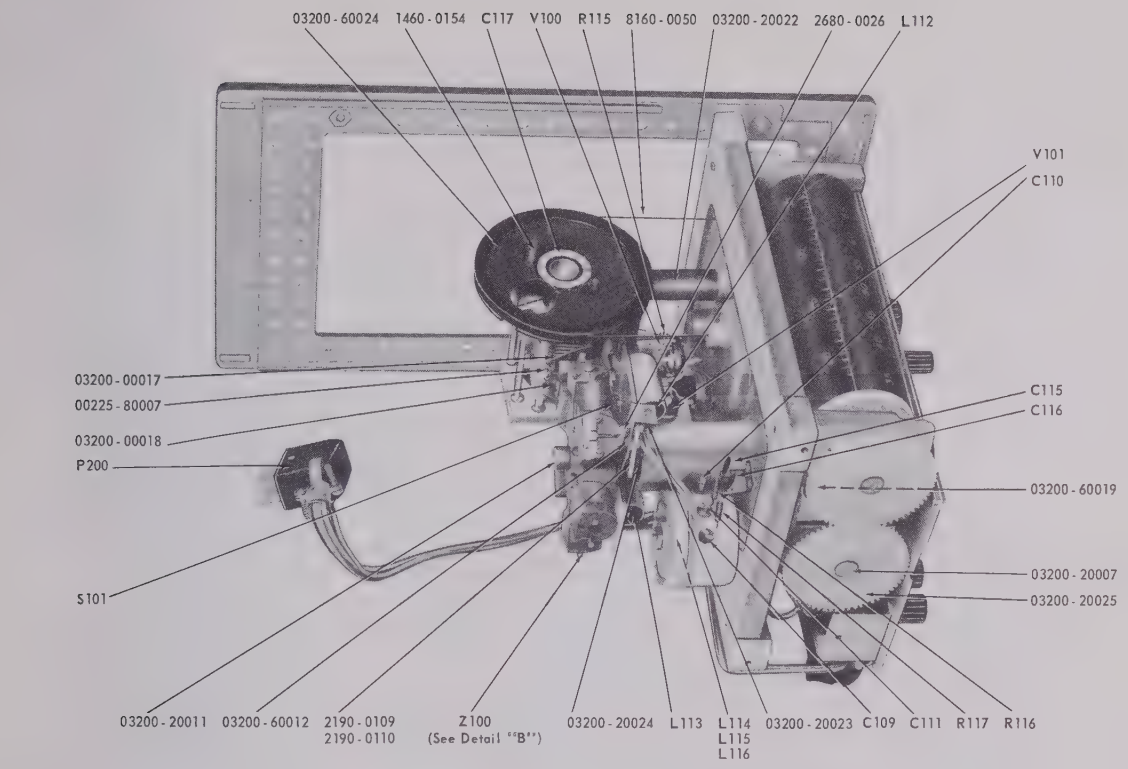
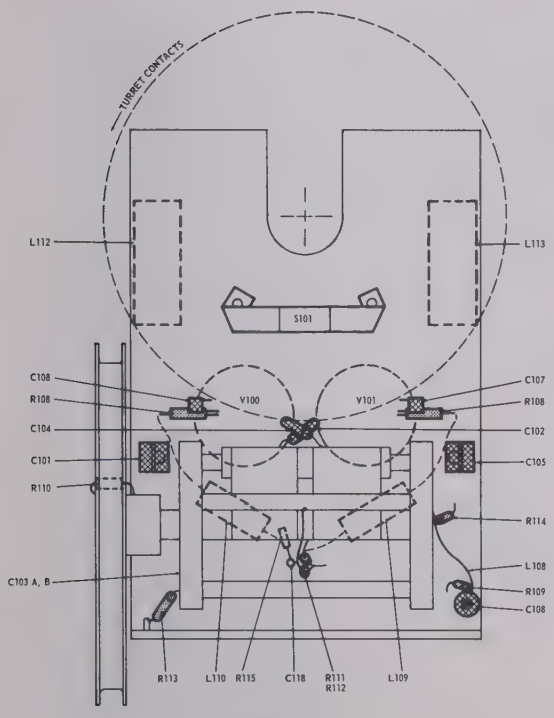
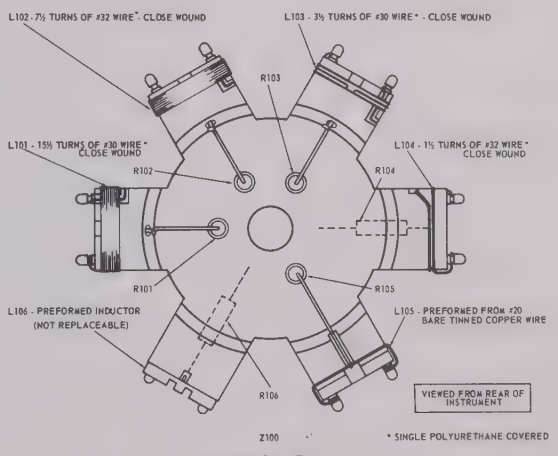


Fig. 18. 3200A — Power Supply





Detail A


L102 - 7½ TURNS OF #32 WIRE*. CLOSE WOUND
L103 - 3½ TURNS OF #30 WIRE* - CLOSE WOUND
R103
L101 - 15½ TURNS OF #30 WIRE* CLOSE WOUND
L104 - 1½ TURNS OF #32 WIRE* CLOSE WOUND
R102
R104
R101
R105
L106 - PREFORMED INDUCTOR (NOT REPLACEABLE)
L105 - PREFORMED FROM #20 BARE TINNED COPPER WIRE
R106
VIEWED FROM REAR OF INSTRUMENT
Z100
* SINGLE POLYURETHANE COVERED

Detail B

Fig. 19. 3200A — RF Oscillator

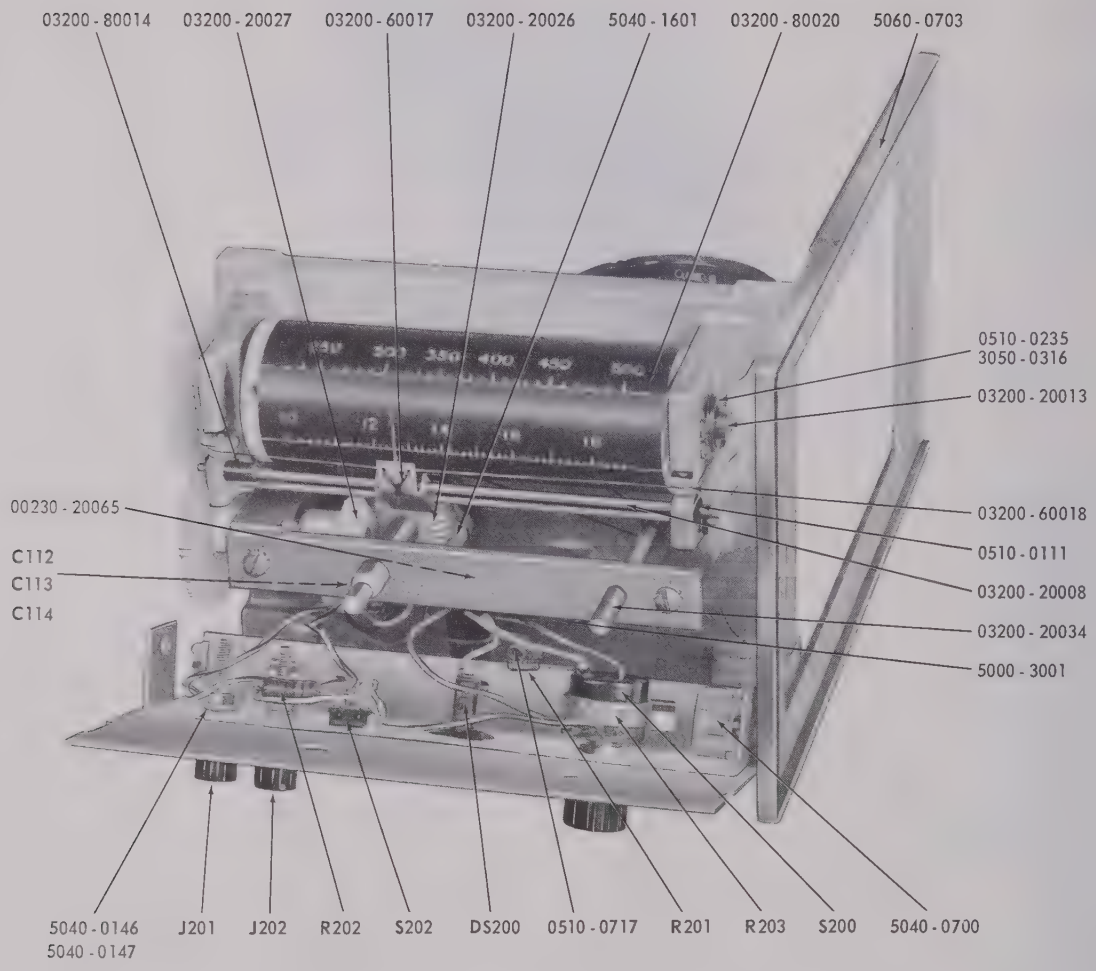


Fig. 20. 3200A — Front View, Front Panel Removed

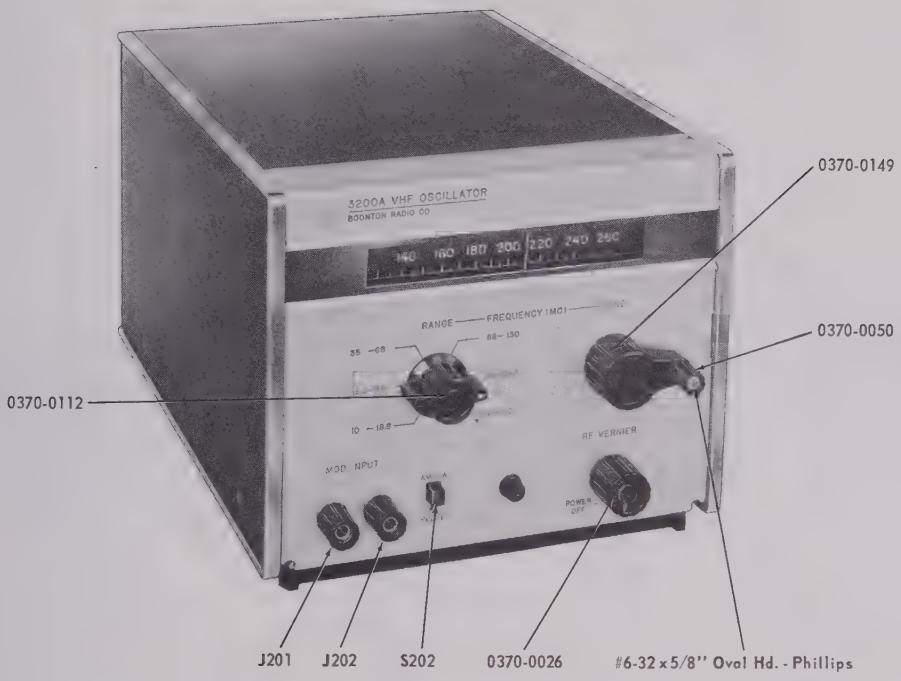


Fig. 21. 3200A — Front View

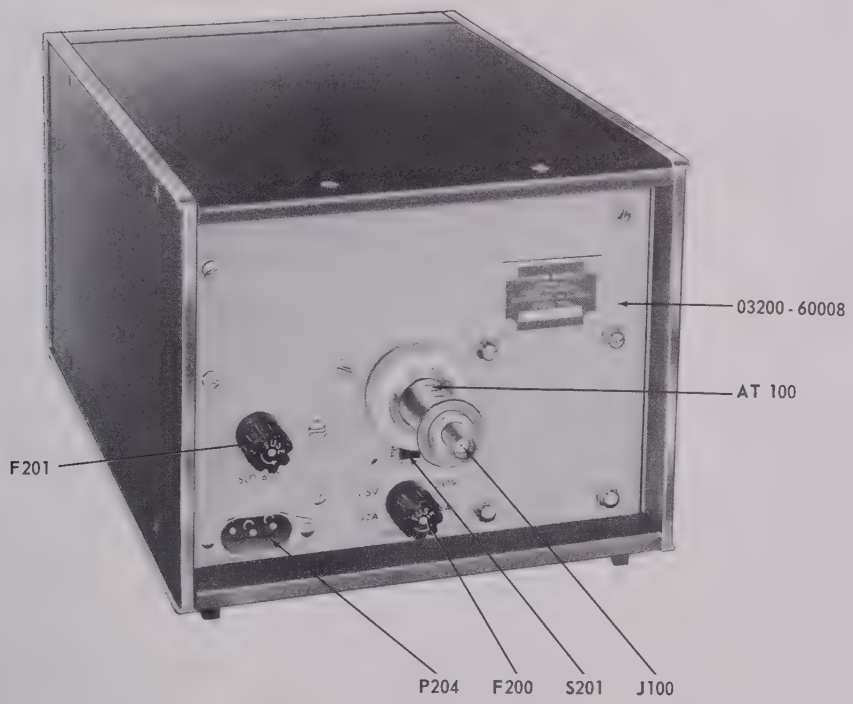


Fig. 22. 3200A — Rear View

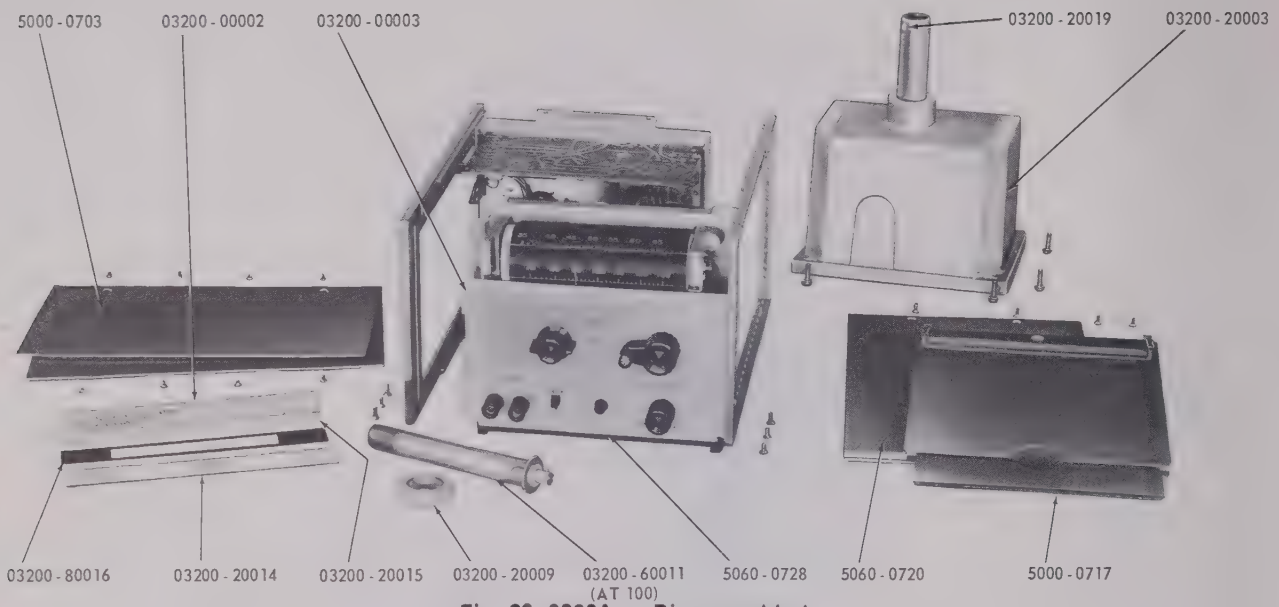
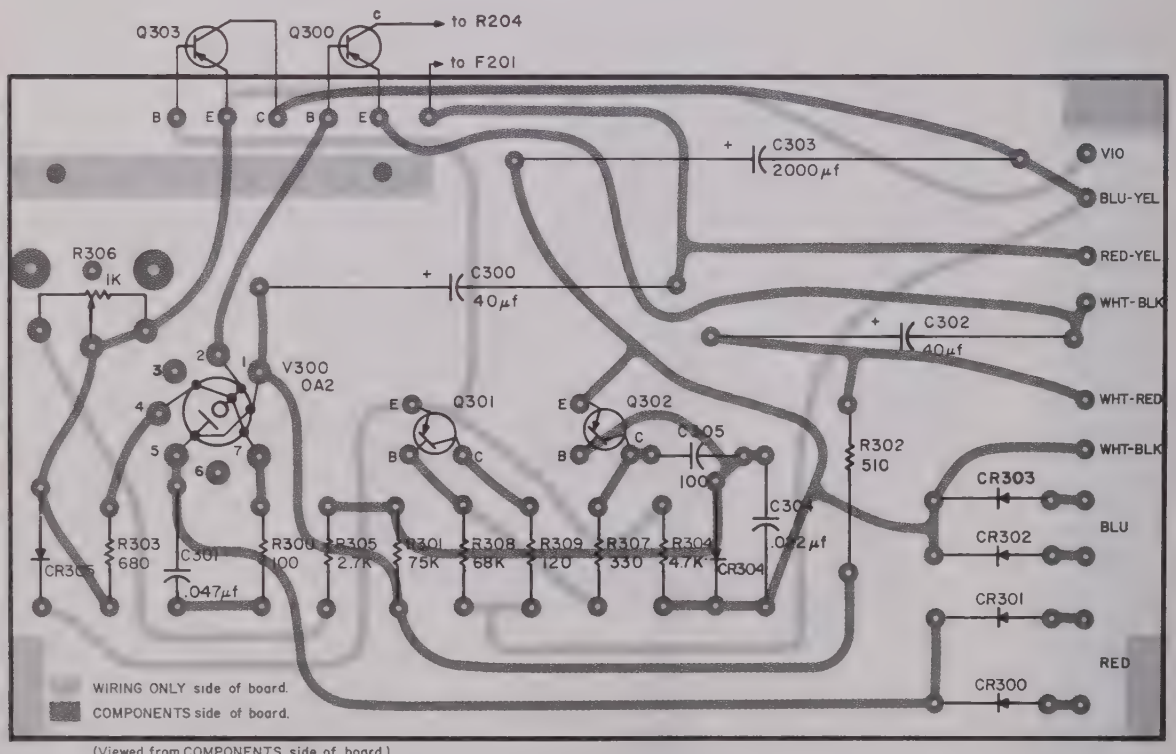


Fig. 23. 3200A — Disassembled



(Viewed from COMPONENTS side of board.)

Fig. 24. Printed Circuit Board (Z300)

Schematic Ref.	Voltage	Resistance	Remarks
A	170 vac	600 Ω	
B	150 vdc	N/S	Regulated B+
C	0 v	0 Ω	B+ Supply & Htr. Common
D	-6.6 vdc	4 Ω	Htr. Supply
E	11 vac	N/S	
F	-6.3 vdc	N/S	
G	-14.8 vdc	N/S	
H	-6.4 vdc	N/S	
I	-15 vdc	N/S	
J	135 vdc	N/S	
K	-6.0 vdc	N/S	
L	-9 to -25 vdc	22K Ω	Voltage depends on Osc. frequency

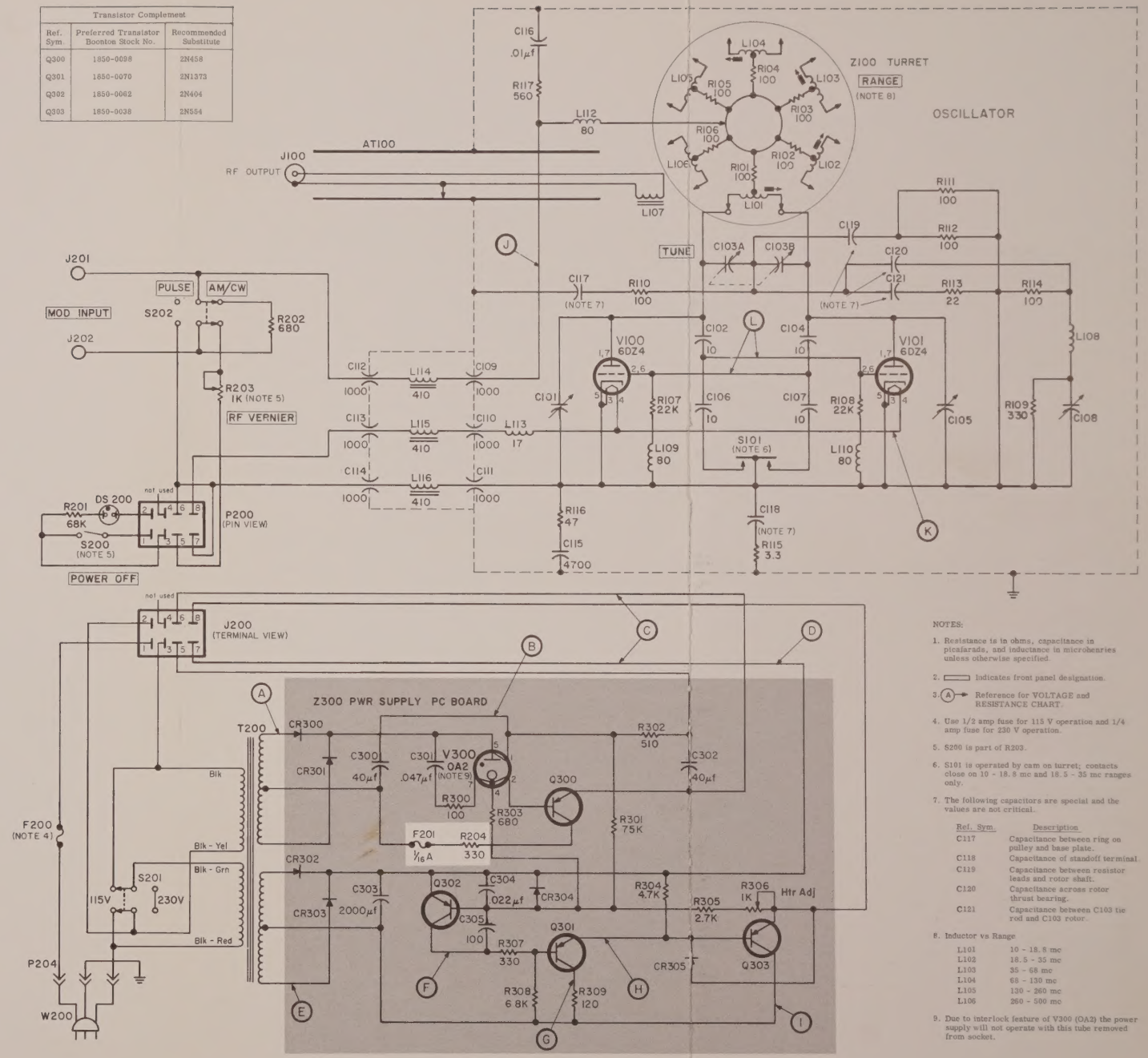
NOTES: 1. All voltages and resistances use the power supply common lead as reference.

2. N/S - not significant

3. Voltages and resistances in this chart are typical except for those indicated in Section VI - Maintenance.

Fig. 25. Voltage and Resistance Chart

Transistor Complement		
Ref. Sym.	Preferred Transistor Boonton Stock No.	Recommended Substitute
Q300	1850-0098	2N458
Q301	1850-0070	2N1373
Q302	1850-0062	2N404
Q303	1850-0038	2N554



NOTES:

1. Resistance is in ohms, capacitance in picofarads, and inductance in microhenries unless otherwise specified.
2. ▭ Indicates front panel designation.
3. Ⓐ→ Reference for VOLTAGE and RESISTANCE CHART.
4. Use 1/2 amp fuse for 115 V operation and 1/4 amp fuse for 230 V operation.
5. S200 is part of R203.
6. S101 is operated by cam on turret; contacts close on 10 - 18.8 mc and 18.5 - 35 mc ranges only.
7. The following capacitors are special and the values are not critical.

Ref. Sym.	Description
C117	Capacitance between ring on pulley and base plate.
C118	Capacitance of standoff terminal.
C119	Capacitance between resistor leads and rotor shaft.
C120	Capacitance across rotor thrust bearing.
C121	Capacitance between C103 tie rod and C103 rotor.

8. Inductor vs Range

L101	10 - 18.8 mc
L102	18.5 - 35 mc
L103	35 - 68 mc
L104	68 - 130 mc
L105	130 - 260 mc
L106	260 - 500 mc

9. Due to interlock feature of V300 (OA2) the power supply will not operate with this tube removed from socket.

Fig. 26. Schematic Diagram — 3200A

364
8
2912
816
160
3960